AISSMS
INSTITUTE OF INFORMATION TECHNOLOGY
(IOIT)
ADDING VALUE TO ENGINEERING
An Autonomous Institute Affiliated to Savitribai Phule Pune University
Approved by AICTE, New Delhi and Recognised by Govt. of Maharashtra
Accredited by NAAC with "A+" Grade | NBA - 5 UG Programmes

ACADEMIC COURSE STRUCTURE

(As per NEP)

INSTRUMENTATION ENGINEERING

B.TECH 4 YEAR UG COURSE

AISSMS INSTITUTE OF INFORMATION TECHNOLOGY
Kennedy Road, Near RTO,
Pune–411001,Maharashtra State,
IndiaEmail:principal@aissmsioit.org,
Website:https://www.aissmsioit.org

Institute Vision & Mission

Vision

To be recognized amongst top 10 private engineering colleges in Maharashtra by the year 2026 by rendering value added education through academic excellence, research, entrepreneurial attitude, and global exposure.

Mission

- To enable placement of 150 plus students in the 7 lacs plus category & ensure 100% placement of all final year students.
- To connect with 10 plus international universities, professional bodies, and organizations to provide global exposure students
- To create conducive environment for career growth, prosperity, and happiness of 100% staff.
- To be amongst top 5 private colleges in Pune in terms of admission cut off

Quality Policy

We commit ourselves to provide quality education & enhance our students quality through continuous improvement in our teaching and learning processes.

Department Vision & Mission

Vision

To be recognized as one of the best instrumentation engineering programs by developing **globally competent engineers, researchers and entrepreneurs** to solve **real life problems through skill-based education.**

Mission

M1: To promote learning for skill-based education and **emerging technologies** to make students **globally competent.**

M2: To create conducive environment for **research, innovations and entrepreneurship.**

Program Educational Objectives (PEOs)

Graduates will

1. solve real life problems by applying the knowledge of instrumentation technology.
2. pursue higher education or be researcher or be entrepreneur.
3. contribute as a socially responsible citizen for the development of nation.

Program Outcomes (POs)

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. [Engineering knowledge]
2. Identify, formulate, research literature, and analyze complex engineering problemsreachingsubstantiatedconclusionsusingfirstprinciplesofmathematics, natural sciences, and engineering sciences. [Problem analysis]
3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. [Design/ development of solutions]
4. Useresearch-basedknowledgeandresearchmethodsincludingdesignofexperiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. [Conduct investigations of complex problems]
5. Create, select, and apply appropriate techniques, resources, and modern engineeringandITtoolsincludingpredictionandmodellingtocomplexengineeringactivities with an understanding of the limitations. [Modern tool usage]
6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. [The engineer and society]
7. Understandtheimpactoftheprofessionalengineeringsolutionsinsocietalandenvironmenta l contexts, and demonstrate the knowledge of, and need for sustainable development. [Environment and sustainability]
8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. [Ethics]
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. [Individual and team work]
10. Communicateeffectivelyoncomplexengineeringactivitieswiththeengineeringcommunity and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. [Communication]
11. Demonstrateknowledgeandunderstandingoftheengineeringandmanagementprinciples and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. [Project management and finance]
12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. [Life-long learning]

Program Specific Outcomes (PSOs)

Graduates will be able to

1. Graduates will be able to apply their knowledge of measurement and control to solve the problems related to environment, safety, health and agriculture sectors.
2. Graduates will be able to demonstrate their skills on Programmable logic controller, LabView, Distributed control system and Internet of things.

Program–Instrumentation Engineering
(Autonomous Curriculum Structure)

A. Definition of Credit

1Hr.Lecture(L) per week	1credit
1Hr.Tutorial(T)per week	1credit
1Hr.Practical(P)per week 2 Hours Practical(Lab)/week	0.5 credits1 credit

B. Range of credits–

Arrange of credits from 160 to 176 for a student to be eligible to get Under Graduate degree in Engineering. A student will be eligible to get Under Graduate degree with Honours or additional Minor Engineering, if he/she completes an additional 20 credits.

C. Credit for Under Graduate Degree in Instrumentation Engineering

Sr. No.	Year	Semester	Credits
1	First Year	I	21
2		II	19
3	Second Year	III	22
4		IV	24
5	Third Year	V	23
6		VI	25
7	Final Year	VII	12
8		VIII	14
		Total Credits	**160**

D. Structure of Undergraduate Engineering program

Sr. no.	Domains	Code	Credits	NEP Suggested
1	Basic Science courses	BSC	**16**	14-18
2	Engineering Science courses	ESC	**16**	12-16
3	Programme Core Courses	PCC	**60**	44-56
4	Programme Elective courses	PEC	**14**	20
5	Open Elective other than particular Programme	OEC	**06**	08
6	Vocational and Skill Enhancement Course	VSE	**08**	08
7	Humanities Social Science and Management	HSM	**12**	14
8	Experiential Learning Courses	ELC	**24**	22
9	Liberal Learning Courses	LLC	**04**	04
Total			**160**	**160-176**

E. Domain wise Credit Distribution

Sr. no.	Code	Credits									
		Semesters								Total	NEP
		I	II	III	IV	V	VI	VII	VIII		
1	BSC	8	8	-	-	-	-	-	-	**16**	14-18
2	ESC	9	7	-	-	-	-	-	-	**16**	12-16
3	PCC	-	-	16	15	13	12	4	-	**60**	44-56
4	PEC	-	-	-	-	4	4	6	-	**14**	20
5	OEC	-	-	3	-	3	-	-	-	**06**	08
6	VSE	1	1	-	3	-	3	-	-	**08**	08
7	HSM	-	-	3	3	3	3	-	-	**12**	14
8	ELC	3	3	-	1	-	1	2	14	**24**	22
9	LLC	-	-	-	2	-	2	-	-	**04**	04
Total Credits		**21**	**19**	**22**	**24**	**23**	**25**	**12**	**14**	**160**	**160-176**
Exam Total		**650**	**650**	**725**	**725**	**725**	**725**	**600**	**600**	**5400**	-
Total Working Hours per Week		**30**	**28**	**26**	**28**	**26**	**30**	**8**	**28**	**202**	**-**

F. Honours Structure: Advanced Industrial Automation

Sr. No.	Code	Courses Name	Semester	Hours perweek			Credit	Examination Scheme					Total
				L	T	P		ISE	ESE	TW	PR	OR	
1	INHDT511	Industrial Networking	V	03	---	--	3	40#	60*	---	---	---	100
2	INHDT614	Computer System Validation	VI	03	---	--	3	40#	60*	---	---	---	100
3	INHDT707	Process Automation	VII	03	--	--	3	40#	60*	---	---	---	100
4	INHDT803	Data Analytics for Automation	VIII	03	--	--	3	40#	60*	--	--	--	100
5	INHDT512	Industrial Networking	V	--	--	02	1	--	--	--	--	50	50
6	INHDT615	Computer System Validation	VI	--	--	02	1	--	--	--	--	50	50
7	INHDT708	Process Automation	VII	--	02	02	2	--	--	50	--	50	100
8	INHDT804	Industrial Networking	VIII	--	02	02	2	--	--	50	--	50	100
			Total	**12**	**04**	**08**	**18**	**160**	**240**	**100**	**--**	**200**	**700**

G. Honors Degree- with Research

Sr. No.	Code	Courses Name	Semester	Hours per week			Credit	Examination Scheme					Total
				L	T	P		ISE	ESE	TW	PR	OR	
1	INHDR708	Research Methodology	VII	3	--	--	**3**	40	60	--	--	--	100
2	INHDR709	Mathematical Modelling	VII	3	--	--	**3**	40	60	--	--	--	100
3	INHDR710	Dissertation I	VII	-	--	4	**2**	--	--	25	--	25	50
4	INHDR804	Paper Publication	VIII	-	--	4	**2**	--	-	50	--	--	50
5	INHDR805	Publication & Ethics	VIII	2	--	--	**2**	--	50	--	--	--	50
6	INHDR806	DissertationII	VIII	--	--	12	**6**	-	-	100	--	50	150
				08	**--**	**20**	**18**	**80**	**170**	**175**	**--**	**75**	**500**

H. Major Courses

Sr. No.	Code	Courses Name	Semester	Hours per week			Credit	Examination Scheme					Total
				L	T	P		ISE	ESE	TW	PR	OR	
1	INPCC302	Data Structure	III	03	---	---	3	40#	60**	---	---	---	**100**
2	INPCC303	Electrical Measurement And Instrumentation	III	03	---	---	3	40#	60*	---	---	---	**100**
3	INPC304	Sensors and Transducers	III	03	---	---	3	40#	60*	---	---	---	**100**
4	INPCC305	Analog& Digital Techniques	III	03	--	---	3	40#	60*	---	---	---	**100**
5	INPCC307	Data Structure Lab	III	---	---	02	1	---	---	25	---	---	**25**
6	INPCC308	Electrical Measurement and InstrumentationLab	III	--	--	02	1	--	--	--	--	25	**25**
7	INPCC309	Sensors and Transducers Lab	III	---	---	02	1	---	---	---	50	---	**50**
8	INPCC310	Analog & Digital Techniques Lab	III	---	---	02	1	---	---	--	50	--	**50**
9	INPCC402	Control System Components	IV	03	---	---	3	40#	60*	---	---	---	**100**
10	INPCC403	Operating System	IV	03	---	---	3	40#	60**	---	---	---	**100**
11	INPCC404	Process Control Loop Components	IV	03	---	---	3	40#	60*	---	---	---	**100**
12	INPCC405	Signals &System	IV	03	--	---	03	40#	60*	--	---	---	**100**
13	INPCC407	Virtual Instrumentation Lab	IV	---	---	02	01	---	---	25	---	---	**25**
14	INPCC408	Process Control Loop Components Lab	IV	---	---	02	01	---	---	---	50	---	**50**
15	INPCC409	PLC and SCADA Programming Lab	IV	--	---	02	01	---	---	25	---	--	**25**

16	INELC410	Project Based Learning Lab	IV	--	--	02	01	--	--	50	--	--	**50**
17	INLLC412	Lifelong Learning Skills-1	IV	--	--	--	01	--	--	--	--	--	**@**
18	INLLC413	Lifelong Learning Skills-2	IV	--	--	--	01	--	--	--	--	--	**@**
19	INPCC502	Control System Design	V	03	01	---	04	40#	60*	---	---	---	**100**
20	INPCC503	Embedded System Design	V	03	01	---	04	40#	60**	---	---	---	**100**
21	INPCC504	Internet of Things	V	03	---	---	03	40#	60*	---	---	--	**100**
22	INPEC505	Professional Elective-I	V	03	---	--	03	40#	60*	---	---	---	**100**
23	INPCC507	Embedded SystemLab	V	---	---	02	01	---	---	---	25	--	**25**
24	INPCC508	Control System Design Lab	V	--	---	02	01	---	---	---	50	---	**50**
25	INPEC509	Professional Elective–I Lab	V	---	---	02	01	---	---	--	---	50	**50**
26	INPCC602	Advanced Embedded System	VI	03	--	---	03	40#	60*	---	---	---	**100**
27	INPCC603	Industrial Automation	VI	03	---	---	03	40#	60*	---	---	---	**100**
28	INPCC604	Project Engineering And Management	VI	03	01	---	04	40#	60*	---	---	---	**100**
29	INPEC605	Professional Elective-II	VI	03	---	---	03	40#	60**	---	---	---	**100**
30	INPCC607	Advanced Embedded System Lab	VI	---	---	02	01	---	---	---	25	---	**25**
31	INPCC608	Industrial AutomationLab	VI	---	---	02	01	---	---	---	50	---	**50**
32	INPEC609	Professional Elective-IILab	VI	---	---	02	01	---	---	---	---	50	**50**
33	INELC610	Mini Project	VI	--	--	02	01	--	--	25	--	--	**25**
34	INLLC612	Lifelong Learning Skills-3	VI	--	--	--	01	--	--	--	--	--	**@**
35	INELC613	Lifelong Learning Skills-4	VI	--	--	--	01	--	--	--	--	--	**@**
36	INPCC701	Process Dynamics and Control	VII	03	---	--	03	40#	60*	---	---	---	**100**
37	INPEC702	Professional Elective -III	VII	03	---	---	03	40#	60*	---	---	---	**100**
38	INPEC703	Professional Elective-IV	VII	02	---	---	02	40#	60*	---	---	---	**100**
39	INPCC704	Process Dynamicsand Control Lab	VII	---	---	02	01	---	---	25	---	50	**75**
40	INPEC705	Professional Elective-IIILab	VII	---	---	02	01	---	---	25	---	50	**75**

41	INELC706	Project Stage-I	VII	---	---	02	01	---	---	100	---	50	**150**
42	INELC801	Internship	VIII	--	--	24	12	**---**	---	200	---	100	**300**
43	INELC802	Project Stage -II	VIII	---	---	04	02	**---**	---	200	---	100	**300**
			Total	**56**	**03**	**64**	**95**	**760**	**1140**	**700**	**300**	**475**	**3375**

I. Minor Courses (Minor in Instrumentation)

Sr. No.	Code	Courses Name	Semester	Hours per week			Credit	Examination Scheme					Total
				L	T	P		ISE	ESE	TW	PR	OR	
1	INMNR301	Sensors and Transducers	III	03	--	--	03	--	75	---	--	---	**75**
2	INMNR302	Sensors and Transducers Lab	III	---	--	02	01	--	---	25	--	---	**25**
3	INMNR401	Process Control Loop Components	IV	03	--	--	03	---	75	---	--	--	**75**
4	INMNR402	Process Control Loop Components Lab	IV	---	--	02	01	--	--	25	---	---	**25**
5	INMNR501	Control System Design	V	03	--	--	03	--	75	--	--	---	**75**
6	INMNR502	Control System Design Lab	V	--	--	02	01	---	--	25	--	---	**25**
7	INMNR601	Industrial Automation	VI	03	--	--	03	---	75	---	--	---	**75**
8	INMNR602	Industrial Automation Lab	VI	---	--	02	01	---	---	25	---	---	**25**
			Total	**12**	**--**	**08**	**16**	---	**300**	**100**	**---**	**--**	**400**

J. Open Elective Courses

Sr. No.	Code	Courses Name	Semester	Hours per week			Credit	Examination Scheme					Total
				L	T	P		ISE	ESE	TW	PR	OR	
1	INOEC306	Control System	III	03	---	--	03	40$	60$$	---	---	--	**100**
2	INOEC506	Biomedical Signal Processing	V	03	---	--	03	40$	60$$	---	---	--	**100**
			Total	**03**	**--**	**--**	**06**	**80**	**120**	**-**	**-**	**--**	**200**

K. Vocational and Skill Enhancement Courses

Sr. No.	Code	Courses Name	Semester	Hours per week			Credit	Examination Scheme					Total
				L	T	P		ISE	ESE	TW	PR	OR	
1	INVSE406	Industrial Safety Engineering	IV	01	---	04	03	---	---	50	50	---	**100**
2	INVSE606	Introductionto Industry 4.0 and Industrial Internet ofThings	VI	01	---	04	03	---	---	50	50	---	**100**
			Total	**02**	**-**	**08**	**06**	**--**	**--**	**100**	100	**-**	**200**

L. Humanities Social Science and Management Course

Sr. No.	Code	Courses Name	Semester	Hours per week			Credit	Examination Scheme					Total
				L	T	P		ISE	ESE	TW	PR	OR	
1	INHSM301	Democracy, Election &Governance	III	02	---	---	02	---	---	25	---	25	**50**
2	INHSM11	Audit Course Vedic Mathematics	III	01	--	--	01	--	--	25	--	--	**25**
3	INHSM41	Industrial Organization And Management	IV	02	---	---	02	---	---	25	---	25	**50**
4	INHSM411	Audit Course Sustainable Development Goals	IV	01	--	--	01	--	--	25	--	--	**25**
5	INHSM501	Intellectual Property Rights	V	02	---	---	02	---	---	25	---	25	**50**
6	INHSM510	Audit Course Foreign Language Level - 1(German/ Japanese)	V	01	--	--	01	---	--	25	--	--	**25**
7	INHSM601	Seminar and Technical Paper Writing	VI	01	---	02	02	---	---	50	---	---	**50**
8	INHSM611	Audit course Foreign Language Level -2 (German/Japanese)	VI	01	--	--	01	--	--	**25**	--	--	**25**
			Total	**11**	-	**02**	**12**	-	-	**225**	--	**75**	**300**

M. Experiential Learning Courses

Sr. No.	Code	Courses Name	Semester	Hours per week			Credit	Examination Scheme					Total
				L	T	P		ISE	ESE	TW	PR	OR	
1	INELC410	Project Based Learning Lab	IV	--	--	02	01	--	--	50	--	--	**50**
2	INELC610	Mini Project	VI	--	--	02	01	--	--	25	--	--	**25**
3	INELC706	Project Stage-I	VII	---	---	02	01	--	--	100	--	50	**150**
4	INELC801	Internship	VIII	--	--	24	12	--	--	200	--	100	**300**
5	INELC802	Project Stage - II	VIII	---	---	04	02	--	--	200	--	100	**300**
			Total	-	-	**34**	**17**	--	--	**575**	--	**250**	**825**

N. Liberal Learning Courses

Sr. No.	Code	Courses Name	Semester	Hours perweek			Credit	Examination Scheme					Total
				L	T	P		ISE	ESE	TW	PR	OR	
1	INLLC412	Lifelong Learning Skills-1	IV	--	--	--	01	--	--	--	--	--	@
2	INLLC413	Lifelong Learning Skills-2	IV	--	--	--	01	--	--	--	--	--	@
3	INLLC612	Lifelong Learning Skills-3	VI	--	--	--	01	--	--	--	--	--	@
4	INLLC613	Lifelong Learning Skills-4	VI	--	--	--	01	--	--	--	--	--	@
			Total	-	-	--	**04**	--	--	--	--	--	

All the students are required to acquire 2 credits, one each from A. and B. which will have grades as below:

A. Extracurricular Activities:

Sr. No.	Activity	Level	Achievement	Grade	Achievement	Grade
1.	Sports	Inter collegiate	Participation	P	Prizewinner	C
		University	Participation	C	Prizewinner	B
		Zonal	Participation	B	Prizewinner	B+
		State	Participation	B+	Prizewinner	A
		National	Participation	A	Prizewinner	A+
		International	Participation	A+	Prizewinner	O
2.	NSS/NCC	Camp	Attended	B		
		Camp+5Activities	Attended	B+		
		Camp+10Activities	Attended	A		
		Camp+15Activities	Attended	A+		
		Camp+20Activities	Attended	O		
3.	Cultural	Inter collegiate	Participation	B	Prizewinner	B+
		State	Participation	B+	Prizewinner	A
		National	Participation	A	Prizewinner	A+
		International	Participation	A+	Prizewinner	O
4.	Community Engagement	Certified by NGO/Authorities withreport and geo-taggedphotograph	1 Activity	B		
			2Activities	B+		
			3Activities	A		
			4Activities	A+		
			5Activities	O		

B. Cocurricular Activities:

		State	Participation	B+	Prizewinner	A
		National	Participation	A	Prizewinner	A+
		International	Participation	A+	Prizewinner	O
Sr. No	Activity	Level	Achievement	Grade	Achievement	Grade
1.	Conference	National	Participation	B	Prize winner	A
		International	Participation	B+	Prize winner	A+
		International (Scopus indexing)	Participation	A+	Prize winner	O
2.	Journal Publication	Non-refereed but recognized and reputed journal/ periodical, having ISSN number.		B		
		Refereed Journal - As listed by UGC		A		
		Refereed Journals- As listed by Scopus		A+		
		Refereed Journals -As listed by SCI/ SCIE		O		
3.	Hackathon		Participation	A+	Prize winner	O
4.	Professional Body	National	Membership	P	3rd Prize	A
			Activities/participation	B	2nd Prize	A+
			5 participations	B+	1st Prize	O
5.	Internship	1 week	Completed	C		
		2 week	Completed	B		
		3 week	Completed	B+	Sponsored Project	A+
		4 week	Completed	A	Job through internship	O
6.	Entrepreneurship	Awareness camp	Attended	A	Product Developed	A+
					Own Startup	O
7.	Project/ Technical events	Inter collegiate	Participation	P	Prize winner	C
		University	Participation	C	Prize winner	B
		Zonal	Participation	B	Prize winner	B+

Any activity other than listed above but having equal weight age should be considered for getting additional credit.

O. Exit Course

Sr. No.	Level	Code	Course Title	Hours per week			Credit	Examination Scheme					
				L	T	P		ISE	ESE	TW	PR	OR	Total
	Certificate course in Sensor Measurement system												
1	Exit course after F.Y	INEX101	Sensors and Transducers Lab	---	---	04	02	--	--	50	--	---	50
2		INEX102	Electrical Measurement And Instrumentation Lab	--	--	04	02	--	--	50	---	--	50
3		INEX103	Internship	--	--	08	04	--	--	100	--	--	100
		Total				**16**	**08**	**--**	**--**	**200**	**--**	**--**	**200**
	Diploma in Embedded Design												
4	Exit course after S.Y	INEX201	Control System Design Lab	--	---	04	02	---	---	50	--	---	50
5		INEX202	Embedded System Design Lab	--		04	02	-	-	50	--	-	50
6		INEX203	Internship	--	--	08	04	--	--	100	--	--	100
		Total				**16**	**08**	**--**	**--**	**200**	**--**	**--**	**200**
	B Vocational in Industrial Automation												
7	Exit course after T.Y	INEX301	Advanced Embedded System	--	--	04	02	--	--	50	--	-	50
8		INEX302	Industrial Automation Lab	--	--	04	02	--	--	50	--	--	50
9		INEX303	Internship	--	--	08	04	--	--	100	--	--	100
		Total		-	-	**16**	**08**	**--**	**--**	**200**	**--**	**--**	**200**

Instrumentation Engineering – Second Year (Semester–III)

Sr. No.	Code	Course Title	Hours per week			Credits	Examination scheme					
			L	T	P		ISE	ESE	TW	PR	OR	Total
1	INHSM301	Democracy, Election & Governance	02	---	---	02	---	---	25	---	25	**50**
2	INPCC302	Data Structure	03	---	---	03	40#	60**	---	---	---	**100**
3	INPCC303	Electrical Measurement And Instrumentation	03	---	---	03	40#	60*	---	---	---	**100**
4	INPCC304	Sensors and Transducers	03	---	---	03	40#	60*	---	---	---	**100**
5	INPCC305	Analog & Digital Techniques	03	--	---	03	40#	60*	---	---	---	**100**
6	INOEC306	Control System	03	---	--	03	40$	60$$	---	---	---	**100**
7	INPCC307	Data Structure Lab	---	---	02	01	---	---	25	---	---	**25**
8	INPCC308	Electrical Measurement and Instrumentation Lab	--	--	02	01	--	--	--	--	25	**25**
9	INPCC309	Sensors and Transducers Lab	---	---	02	01	---	---	---	50	---	**50**
10	INPCC310	Analog & Digital Techniques Lab	---	---	02	01	---	---	--	50	--	**50**
11	INHSM311	Audit Course Vedic Mathematics	01	--	--	01	--	**--**	25	--	--	**25**
		Total	**18**	**00**	**08**	**22**	**200**	**300**	**75**	**100**	**50**	**725**

* **EndSemester Examination (ESE)** based on subjective questions.

** **Practical or Activity based Evaluation.**

\# **InSemester Evaluation** based on Presentation/GroupDiscussion/LaboratoryWork/CourseProject/HomeAssignment/ComprehensiveVivaVoce/BlogWriting/CaseStudy/Survey/Multiple-Choice Question (MCQ) examination/subjective questions.

$ **For MOOCs:** Assignments marks will be converted on the scaleof 40 marks.

$$ **For MOOCs:** Score of examination conducted by the respective authority of MOOC or Score of ESE Conducted by Institute will be converted on the scale of 60 marks.

MOOC: Control System: https://onlinecourses.nptel.ac.in/noc22_de09/preview

Instrumentation Engineering –Second Year (Semester–IV)

Sr. No.	Code	Course Title	Hours per week			Credits	Examination scheme					
			L	T	P		ISE	ESE	TW	PR	OR	Total
1	INHSM401	Industrial Organization and Management	02	---	---	02	---	---	25	---	25	**50**
2	INPCC402	Control System Components	03	---	---	03	40#	60*	---	---	---	**100**
3	INPCC403	Operating System	03	---	---	03	40#	60**	---	---	---	**100**
4	INPCC404	Process Control Loop Components	03	---	---	03	40#	60*	---	---	---	**100**
5	INPCC405	Signals & System	03	--	---	03	40#	60*	--	---	---	**100**
6	INVSE406	Industrial Safety Engineering	01	---	04	03	--	--	50	50	---	**100**
7	INPCC407	Virtual Instrumentation Lab	---	---	02	01	---	---	25	---	---	**25**
8	INPCC408	Process Control Loop Components Lab	---	---	02	01	---	---	---	50	---	**50**
9	INPCC409	PLC and SCADA Programming Lab	--	---	02	01	---	---	25	---	--	**25**
10	INELC410	Project Based Learning Lab	--	--	02	01	--	--	50	--	--	**50**
11	INHSM411	Audit Course Sustainable Development Goals	01	--	--	01	--	--	25	--	--	25
12	INLLC412	Lifelong Learning Skills-1	**--**	**--**	**--**	01	**--**	**--**	**--**	**--**	**--**	**@**
13	INLLC413	Lifelong Learning Skills-2	**--**	**--**	**--**	01	**--**	**--**	**--**	**--**	**--**	**@**
Total			**16**	**00**	**12**	**24**	**160**	**240**	**200**	**100**	**25**	**725**

* **EndSemester Examination (ESE)** based on subjective questions.

** **Practical or Activity based Evaluation.**

\# **InSemester Evaluation**
basedonPresentation/GroupDiscussion/LaboratoryWork/CourseProject/HomeAssignment/Comprehensive Viva Voce / Blog Writing/ Case Study /Survey/Multiple-Choice Question (MCQ) examination/subjective questions.

$ **For MOOCs:** Assignments marks will be converted on the scale of 40 marks.

$$ **For MOOCs:** Score of examination conducted by the respective authority of MOOC or Score of ESE Conducted by Institute will be converted on the scale of60marks.

@ Refer heading N. Lifelong learning skill course for grades

MOOC: Industrial Safety Engineering: https://onlinecourses.nptel.ac.in/noc22_mg97/preview

Note: Students are required to undergo industrial internship of 2 weeks in summer vacation and submit report at the beginning of next year.

Instrumentation Engineering –Third Year (Semester–V)

Sr. No.	Code	Course Title	Hours per week			Credits	Examination scheme					
			L	T	P		ISE	ESE	TW	PR	OR	Total
1	INHSM501	Intellectual Property Rights	02	---	---	02	---	---	50	---	--	**50**
2	INPCC502	Control System Design	03	01	---	04	40#	60*	---	---	---	**100**
3	INPCC503	Embedded System Design	03	01	---	04	40#	60**	---	---	---	**100**
4	INPCC504	Internet of Things	03	---	---	03	40#	60*	---	---	--	**100**
5	INPEC505	Professional Elective-I	03	---	--	03	40#	60*	---	---	---	**100**
6	INOEC506	Biomedical Signal Processing	03	---	--	03	40$	60$$	---	---	---	**100**
7	INPCC507	Embedded System Lab	---	---	02	01	---	---	---	--	50	**50**
8	INPCC508	Control System Design Lab	--	---	02	01	---	---	---	50	---	**50**
9	INPEC509	Professional Elective –I Lab	---	---	02	01	---	---	--	---	50	**50**
10	INHSM510	Audit Course Foreign Language Level - 1(German/ Japanese)	01	--	--	01	---	--	25	--	--	**25**
Total			**18**	**02**	**06**	**23**	**200**	**300**	**75**	**50**	**100**	**725**

ProfessionalElective-IINPEC505	
1	Biomedical Instrumentation
2	Digital Signal Processing
3	Data Science

* **EndSemester Examination (ESE)** based on subjective questions.

** **Practical or Activity based Evaluation.**

\# **In Semester Evaluation** based on Presentation/GroupDiscussion/LaboratoryWork/CourseProject/HomeAssignment/Comprehensive Viva Voce/Blog Writing/Case Study/Survey/Multiple-Choice Question(MCQ) examination/subjective questions.

$ **For MOOCs:** Assignments marks will be converted on the scale of 40 marks.

$$ **For MOOCs:** Score of examination conducted by the respective authority of MOOC or Score of ESE Conducted by Institute will be converted on the scale of 60 marks.

MOOC: Biomedical Signal Processing: https://onlinecourses.nptel.ac.in/noc22_ee19/preview

Instrumentation Engineering–Third Year (Semester–VI)

Sr. No.	Code	Course Title	Hours per week			Credits	Examination scheme					
			L	T	P		ISE	ESE	TW	PR	OR	Total
1	INHSM601	Seminar and Technical Paper Writing	01	---	02	02	---	---	50	---	---	**50**
2	INPCC602	Advanced Embedded System	03	--	---	03	40#	60*	---	---	---	**100**
3	INPCC603	Industrial Automation	03	---	---	03	40#	60*	---	---	---	**100**
4	INPCC604	Project Engineering And Management	03	01	---	04	40#	60*	---	---	---	**100**
5	INPEC605	Professional Elective-II	03	---	---	03	40#	60**	---	---	---	**100**
6	INVSE606	Introduction to Industry 4.0 and Industrial Internet of Things	01	---	04	03	--	--	50	50	---	**100**
7	INPCC607	Advanced Embedded System Lab	---	---	02	01	---	---	---	25	---	**25**
8	INPCC608	Industrial Automation Lab	---	---	02	01	---	---	---	50	---	**50**
9	INPEC609	Professional Elective-II Lab	---	---	02	01	---	---	---	---	50	**50**
10	INELC610	Mini Project	--	--	02	01	--	--	25	--	--	**25**
11	INLLC611	Lifelong Learning Skills-3	**--**	**--**	**--**	01	**--**	**--**	**--**	**--**	**--**	**@**
12	INLLC612	Lifelong Learning Skills-4	**--**	**--**	**--**	01	**--**	**--**	**--**	**--**	**--**	**@**
13	INHSM613	Audit course Foreign Language Level -2 (German/ Japanese)	01	--	**--**	01	**--**	**--**	**25**	**--**	**--**	**25**
Total			**15**	**01**	**14**	**25**	**200**	**300**	**150**	**125**	**50**	**725**

ProfessionalElective-IIINPEC605	
1	Machine Learning
2	Automotive Instrumentation
3	Building Automation

* **End Semester Examination(ESE)** based on subjective questions.

** **Practical or Activity based Evaluation.**

\# **InSemester Evaluation** based on Presentation/GroupDiscussion/LaboratoryWork/CourseProject/HomeAssignment/ComprehensiveViva Voce/ Blog Writing/Case Study/Survey/Multiple-Choice Question (MCQ)examination/subjective questions.

$ **For MOOCs :** Assignments marks will be converted on the scale of 40 marks.

@ Refer heading N. Lifelong learning skill course for grades

MOOC: Introduction to Industry 4.0 and Industrial Internet of Things: https://onlinecourses.nptel.ac.in/noc20_cs69/preview

Note: Students are required to undergoing industrial internship of 4 weeks in summer vacation and submit report at the beginning of next year

Instrumentation Engineering–Final Year (Semester–VII)

Sr. No.	Code	Course Title	Hours per week			Credits	Examination scheme					
			L	T	P		ISE	ESE	TW	PR	OR	Total
1	INPCC701	Process Dynamics and Control	03	---	--	03	40#	60*	---	---	---	**100**
2	INPEC702	Professional Elective -III	03	---	---	03	40#	60*	---	---	---	**100**
3	INPEC703	Professional Elective-IV	03	---	---	03	40#	60*	---	---	---	**100**
4	INPCC704	Process Dynamics and Control Lab	---	---	02	01	---	---	25	---	50	**75**
5	INPEC705	Professional Elective-III Lab	---	---	02	01	---	---	25	---	50	**75**
6	INELC706	Project Stage-I	---	---	02	01	---	---	100	---	50	**150**
		Total	**09**	**--**	**06**	**12**	**120**	**180**	**150**	**--**	**150**	**600**

ProfessionalElective-IIIINPEC702		ProfessionalElective-IVINPEC703
1	Industrial Robotics MOOCS	Nonlinear Adaptive Control MOOCS
2	Cloud Computing MOOCS	Cyber Security in Automation MOOCS
3	Deep Learning MOOCS	Data Analytics MOOCS

* **EndSemester Examination (ESE)** based on subjective questions.

** **Practical or Activity based Evaluation.**

\# **InSemester Evaluation** based on Presentation/GroupDiscussion/LaboratoryWork/CourseProject/HomeAssignment/ComprehensiveViva Voce/Blog Writing/Case Study/Survey/Multiple-Choice Question (MCQ) examination/subjective questions.

$ **For MOOCs:** Assignments marks will be converted on the scale of 40 marks.

$$ **For MOOCs:** Score of examination conducted by the respective authority of MOOC or Score of ESE Conducted by Institute will be converted on the scale of 60 marks.

Note: Students should submit the choice of Semester VII / Semester VIII tobe complete in first preference. It is mandatory to submit the preference of semester completion at the end of Semester VI.

Instrumentation Engineering–Final Year (Semester–VIII)

Sr. No.	Code	Course Title	Hours per week			Credits	Examination scheme					
			L	T	P		ISE	ESE	TW	PR	OR	Total
1	INELC801	Internship	--	--	24	12	---	---	200	---	100	**300**
2	INELC802	Project Stage-II	---	---	04	02	---	---	200	---	100	**300**
Total			**--**	**---**	**28**	**14**	**---**	**---**	**400**	**--**	**200**	**600**

Elective:

Professional Elective-I INPEC505	Professional Elective-II INPEC605	Professional Elective-III INPEC702	Professional Elective-IV INPEC703
Biomedical Instrumentation	Machine Learning	Industrial Robotics MOOCS	Nonlinear Adaptive Control MOOCS
Digital Signal Processing	Automotive Instrumentation	Cloud Computing MOOCS	Cyber security in Automation MOOCS
Data Science	Building Automation	Deep Learning MOOCS	Data Analytics MOOCS

Second Year Instrumentation Engineering Democracy, Election and Governance			
Course Code:	**INHSM301**	**Credit**	**2**
Contact Hours:	2 Hrs/week (L)	**Type of Course:**	Lecture
Examination Scheme	Term-work 25 Marks	Oral 25 Marks	

Pre-requisites:

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term-work	Internal	25
2.	Oral	External	25

Course Objectives	
1	To introduce the students meaning of democracy and the role of the governance.
2	To help them understand the various approaches to the study of democracy and governance.

Course Outcomes: Students will be able to	
301.1	Know the meaning of democracy and the role of the governance in life
301.2	Understand the various approaches to the democracy and governance

Topics covered:

Unit I. **Democracy- Foundation and Dimensions (5 hrs.)**

a. Constitution of India
b. Evolution of Democracy- Different Models
c. Dimensions of Democracy- Social, Economic, and Political

Unit II: **Decentralization (5 hrs.)**

a. Indian tradition of decentralization
b. History of panchayat Raj institution in the lost independence period
c. 73rd and 74th amendments

Challenges of caste, gender, class, democracy and ethnicity

Unit-III: Governance (5 hrs.)

a. Meaning and concepts
b. Government and governance
c. Inclusion and exclusion

Text Books:

1. Banerjee-Dube, I. (2014). *A history of modern India*. Cambridge UniversityPress.
2. Basu, D. D. (1982). *Introduction to the Constitution of India*. Prentice Hall ofIndia.
3. Bhargava, R. (2008). *Political theory: An introduction*. Pearson EducationIndia.
4. Bhargava, R., Vanaik, A. (2010) *Understanding Contemporary India: Critical Perspective.* New Delhi: Orient Blackswan.
5. Chandhoke. N., Proyadardhi.P, (ed) (2009), '*Contemporary India: Economy, Society, Politics*', Pearson India Education Services Pvt. Ltd, ISBN 978-81- 317-1929-9.
6. Chandra, B. (1999). *Essays on contemporary India*. Har-Anand Publications.
7. Chaterjee, P. (1997). State and Politics in India.
8. Dasgupta. S., (ed) (2011), *'Political Sociology'*, Dorling Kindersley (India)Pvt. Ltd., Licensees of Pearson Education in south Asia. ISBN: 978-317-6027- 7.
9. Deshpande, S. (2003). Contemporary India: A Sociological View, New Delhi:Viking Publication.
10. Guha, R. (2007). India After Gandhi: The History of the World's Largest. *Democracy, HarperCollins Publishers, New York.*
11. Guha, R. (2013). *Gandhi before India*. Penguin UK.
12. Jayal. N.G. (2001). *Democracy in India.*New Delhi: Oxford University Press.
13. Kohli, A. (1990). *Democracy and discontent: India's growing crisis ofgovernability*. Cambridge University Press.
14. Kohli, A., Breman, J., & Hawthorn, G. P. (Eds.). (2001). *The success of India'sdemocracy* (Vol. 6). Cambridge University Press.
15. Kothari, R. (1989). *State against democracy: In search of humane governance*.Apex Pr.
16. Kothari, R. (1970). *Politics in India*. New Delhi: Orient Blackswan.
17. Kothari, R. (1995). *Caste in Indian politics.* Orient Blackswan.
18. Sarkar, S. (2001). *Indian democracy: the historical inheritance. the Succ*edition

मराठी संदर्भ ग्रंथ:

१. राही श्रुती गणेश., आवटे श्रीरंजन, (२०१९), *'आपलं आयकार्ड'*, सुहास पळशीकर द युनिक अॅकॅडमी पब्लिकेशनप्रा.लि.,.

२. व्होरा राजेंद्र., पळशीकर, सुहास.(२०१४). *भारतीय लोकशाही अर्थ आणि व्यवहार.* पुणे : डायमंड प्रकाशन.

३. सुमंत, यशवंत.(२०१८). *प्रा. यशवंत सुमंत यांची तीन भाषणे.* पुणे : युनिक अॅकॅडमी पब्लिकेशन्स प्रा.लि

४. भोळे. भा.ल. (२०१५). *भारतीय गणराज्याचे शासन आणि राजकारण.* नागपूर: पिंपळापुरे बुक प्रकाशन

५. कसबे. रावसाहेब. (२०१०)डॉ. आंबेडकर आणि भारतीय राज्यघटना. पुणे: सुगावा प्रकाशन

Second Year Instrumentation Engineering Data Structure			
Course Code:	**INESC302**	**Credit**	**3**
Contact Hours:	3 Hrs/week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Pre-requisites: Problem Solving and Programming II

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-Sem. Evaluation	Internal	40
2.	End Semester Examination	External	60

Course Objectives	
1	To introduce the types of data structures.
2	To explain different searching and sorting techniques.
3	To describe operations and applications of various data structures.
4	To explain selection of data structure while programming.

Course Outcomes: Students will be able to	
302.1	Explain the basics of data structure
302.2	Apply various operations on arrays and matrix.
302.3	Compare and apply different searching and sorting algorithms.
302.4	Implement various types of linked lists
302.5	Explain implementation methods and applications of stack
302.6	Apply various operations on queues.

Topics covered:

Unit I: Introduction to Data Structures (6 hrs)
Concept of data, Data structure, Classification of Data Structure (Linear and Non-linear, Static and Dynamic, Persistent and Ephemeral data structures), Definition of Abstract Data Type(ADT).

Unit II: Array and Matrix (6 hrs)
Overview of Array, Array as an Abstract Data Type, Two Dimensional Array: Implementation of 2 Dimensional array, Basic Operations, Element Access, Merging of two arrays, Storage

Representation and their Address Calculation: Row major and Column Major, n-dimensional arrays
Matrix: Implementation of matrix, Matrix operations like addition, subtraction, scaling, multiplication, transpose.

Unit III: Searching and Sorting (6 hrs)
Searching: Search Techniques-Sequential /Linear Search, Binary Search, Fibonacci Search, and Indexed Sequential Search.
Sorting: Sorting types-Internal and External Sorting, General Sort Concepts-Sort Order, Stability, Efficiency, and Number of Passes, Comparison Based Sorting Methods-Bubble Sort, Insertion Sort, Selection Sort, Quick Sort, Shell Sort, Non-comparison Based Sorting Methods-Radix Sort, Counting Sort, and Bucket Sort.

Unit IV: Link Structures (6 hrs)
Introduction of Linked List, Types of Linked List: Singly linked list, Doubly Linked List, and Circular Linked Lists, Primitive Operations on Linked List: Create, Traverse, Search, Insert, Delete, Sort, Concatenate.
The Bag: Linked List Implementation

Unit V: Stacks (6 hrs)
Concept of stack, Implementing the Stack using a Python List and using a Linked List, Stack operations, Multiple Stacks, Stack Applications: Balanced Delimiters, Evaluating Postfix Expressions, Converting from Infix to Postfix, Postfix Evaluation Algorithm.

Unit VI: Queues (6 hrs)
Queues: Implementing the Queue: Using a Python List and using a Linked List, Queue Operations,
Circular Queue, Linked Queue, Multi-queues, Deque-Basic concept, types (Input restricted and Output restricted), Priority Queues: Types (Ascending and Descending)

Text Books:

1. Rance D. Necaise, Data Structures and Algorithms Using Python by, John Wiley and Sons. ISSN: 788126562169
2. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, “Data Structures and Algorithms in Python”, Wiley Publication, ISBN: 978-1-118-29027-9
3. Reema Thareja, “Python Programming Using Problem Solving Approach”, Oxford University Press, ISBN 13: 978-0-19-948017-6.

References Books:

1. Narasimha Karumanchi, Data Structures And Algorithms Made Easy, Career Monk Publications
2. Y Daniel Liang, “Introduction to Programming using Python”, Pearson.
3. Benjamin Baka, David Julian, “Python Data Structures and Algorithms”, Packt Publishers,2017
4. Yashwant Kanetkar & A. Kanetkar, “Let us Python”, BPB Publisher, ISBN: 9789389845006

Second Year Instrumentation Engineering Electrical Measurements and Instrumentation			
Course Code:	**INESC303**	**Credit**	**3**
Contact Hours:	3 Hrs/week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Pre-requisites:

- Basic knowledge of electrical engineering, laws, components, thevenin's theorem

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-Sem. Evaluation	Internal	40
2.	End Semester Examination	External	60

Course Objectives	
1	To introduce static and dynamic performance characteristics of instruments.
2	To provide basic understanding of design of multirange ammeter and voltmeter
3	To explain the construction and working of instruments.
4	To introduce the application of analog and digital instruments.

Course Outcomes: Students will be able to	
303.1	Define static and dynamic characteristics to indicate the performance of instruments.
303.2	Calculate the values of resistances for design of multirange ammeter, voltmeter and ohmmeter
303.3	Determine the magnitude and frequency of given signal by CRO using Y-t, lissajous and Z-modulation techniques.
303.4	Compute the resistance, inductance and capacitance by DC and AC bridges and use it as signal conditioning circuit for resistive, inductive and capacitive transducers.
303.5	Explain types of ADCs and DACs to be used in digital instrumentation systems.
303.6	Explain types of graphical recorders and application in measurement

Topics covered:

Unit I: Fundamentals of Measurement (07 hrs)

Need of Instrumentation, General Measurement System, Classification of Instruments, Static and Dynamic characteristics of instruments, Error: limiting error, Types of Errors. Loading effect: Input impedance and admittance of load & output impedance and admittance of source,

loading effects of series and shunt connected instruments, Calibration: Definition, calibration report & certification, traceability, and traceability chart.

Unit II: Analog Indicating Instruments (08 hrs)

PMMC, Galvanometer, Moving Iron instrument, RMS and True RMS concept, Extension of range of ammeter, design of multirange ammeter, conversion of ammeter to voltmeter, extension of range of voltmeter, design of multirange voltmeter, series and shunt type ohmmeter, Single phase wattmeter: construction and working.

Unit III: Oscilloscope (06 hrs)

General purpose oscilloscope Block Diagram, Cathode Ray Tube, front panel controls, Oscilloscope Probes 1:1 and 10:1, Dual trace CRO, ALT and CHOP modes, measurement of electrical parameters like voltage, current, frequency and phase, frequency measurement by Lissajous pattern and Z-modulation.

Digital Storage oscilloscope block diagram, sampling rate, bandwidth, roll mode.

Unit IV: Bridges (07 hrs)

DC bridges:

Wheatstone bridge construction and general balance condition, errors in bridge circuits, bridge sensitivity, Kelvin bridge, Kelvin double bridge, applications of DC bridges.

AC bridges:

Quality factor (Q) and dissipation factor(D), General equations for bridge balance, detectors for AC bridges, Maxwell's bridges, Hay bridge, Schering bridge, Wien bridge, applications of AC bridges.

Unit V: Digital Instruments (08 hrs)

Block diagram of digital instrument, Need of ADC, ADC specifications, selection criteria of ADC, Need of DAC, DAC specifications, selection criteria of DAC, Advantages and disadvantages of Digital instruments over Analog instruments, Accuracy of digital instruments, resolution of digital instrument, Displays: 7-segment display ($3\frac{1}{2}$, $3\frac{3}{4}$), LCD, digital instruments like Digital Multimeter, Digital energy meter, Digital Clamp meter.

Unit VI: Graphical Recording Instruments (06 hrs)

Definition of recorder, classification of recorder, marking mechanisms, tracing curves, Basic Strip chart recorder, Types of Stripart recorder, XY Recorder, Application of recorders

Text Books:

1. Sawhney A. K, "Electrical and Electronics Measurements and Instruments" Dhanpat Rai & Co. 02nd Ed
2. W. D. Cooper & A. D. Helfrick, "Electronic Instrumentation and Measurement Techniques" PHI, 4th e/d, 1987
3. David A.Bell," Electronic Instrumentation and Measurements", PHI, 2e/d

Reference Books:

1. Anand M. M. S., "Electronic Instruments and Instrumentation Technology", PHI, 2004, 02nd Ed.
2. Kalsi H. S., " Electronic Instrumentation", TMH, 2nd or 3rd e/d, 2004/2010.
3. R. Subburaj, "Calibration the Foundation for ISO 9000 and TMQ"
4. Bouwens A. J., "Digital Instrumentation", McGraw-Hill, second edition

Second Year Instrumentation Engineering Sensors and Transducers			
Course Code:	**INPCC 304**	**Credit**	**3**
Contact Hours:	3 Hrs/week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Pre-requisites:

- Basic knowledge of Electrical & Electronics Engineering.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-Sem. Evaluation	Internal	40
2.	End Semester Examination	External	60

Course Objectives	
1	To make students familiar with Sensors & its applications.
2	To discuss constructions and working principle of different types of sensors and transducers.
3	To make students aware about the construction, operation various features of sensors and transducers.
4	To familiar with different measuring instruments and the methods of measurement
5	To impart skills to evaluate the performance of methods of measurement and the use of different transducers.

Course Outcomes: Students will be able to	
304.1	Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc
304.2	Understand correctly the expected performance of various sensors
304.3	List and locate different type of sensors used in real life applications and paraphrase their importance
304.4	Outline and Use the concepts in common methods for converting a physical parameter into an electrical quantity.
304.5	Classify and explain with examples of transducers, including those for measurement of temperature, strain, motion, position and light
304.6	Develop professional skills in acquiring and applying the knowledge outside the classroom through design of a real-life instrumentation system

Topics covered:

UNIT I: DISPLACEMENT AND SPEED MEASUREMENT (6 hrs.)

Need of sensors and transducers, transducers definition, classification, performance characteristics and selection criteria.

Displacement Measurement: resistive-potentiometers, inductive-LVDT and RVDT, capacitive, piezoelectric, ultrasonic and proximity sensors.

Speed Measurement: Tachometer, Magnetic pickups, Encoders, Photoelectric pickups,

UNIT II: FORCE AND TORQUE & VIBRATION MEASUREMENT (6 hrs.)

Force transducer: Basic methods of force measurement, Elastic force transducer, Load cell, LVDT, Piezo electric transducer.

Torque Transducer: Strain gauge torque measurement , inductive and magnetostrictive torque measurement

Vibration Measurement: Piezoelectric, Seismic

UNIT III: PRESSURE MEASUREMENT (6 hrs.)

Pressure scales and standards, Types of Pressure: Gauge pressure, Absolute pressure, Differential pressure, Vacuum pressure

Types of Pressure sensor: Dead weight tester, vacuum pressure sensor, Bourdon tube, Manometers

Elastic Pressure sensor: Bellows, bourdon tubes, diaphragm.

UNIT IV: Temperature measurement (6 hrs.)

Temperature scales, classification,

Thermometer- types of thermometer, filled system thermometer,

RTD-Material used, types 2 wire,3 wire & 4 wire, application of RTD,

Thermistor –Material used, type (NTC , PTC) and it's application.

Thermocouples- Material used, Types(A,B,C,D,E,J,K,R,S,T), laws of thermocouples, cold junction compensation method.

Semiconductor temperature sensors- Diode & IC temperature sensor LM35.

UNIT V- FLOW MEASUREMENT (6 hrs.)

Units, Classification of flow: Newtonian and non-Newtonian fluids, Reynolds's number, laminar and turbulent flows, velocity profile, Bernoulli's equation for incompressible flow, head type flow meters (orifice, venture meter and pitot tube), variable area type, turbine, electromagnetic ultrasonic, vortex shedding, anemometers , mass flow meter: Coriolis flow meter.

UNIT VI- LEVEL AND MISCELLANEOUS MEASUREMENT (6hrs.)

Level Measurement: Dipstick displacer, float, Bubblers method, Diaphragm level detector, laser level sensor, time domain reflectometry, ultrasonic level detector.

Viscosity: Saybolt, Searle's rotating cylinder, Cone and plate, Falling and rolling ball, Rotameter.

Density: Chain-balanced float type, Hydrometer (Buoyancy type), Hydrostatic Head (Air bubbler).

Humidity: resistive and capacitive type sensors

Miscellaneous Sensors: pH sensors, Conductivity sensors.

Text Books:

1. Principle of Industrial Instrumentation by D. Patranabis, Tata McGraw Hill, 2nd Ed.
2. Instrumentation and Measurement Principles by . D.V.S. Murty, PHI, New Delhi, 2nd Ed.
3. Electrical and Electronics Measurement and Instrumentation by A.K. Sawhney, Dhanpat Rai & Co, 2nd Ed.
4. Process control instrumentation technology by Curtis D. Johnson, PHI learning Pvt. Ltd, 07th Ed.

Reference Books:

1. Measurement Systems by E.O. Doebelin, McGraw Hill, 06th Ed.
2. Process Measurement & Analysis by B.G. Liptak, CRC press, 04th Ed.
3. Instrumentation Devices and Systems by C. S. Rangan, G. R. Sharma and V. S. Mani, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 02nd Ed.
4. Mechanical and Industrial Measurements by R. K. Jain, Khanna Publishers, 02nd Ed.

Second Year Instrumentation Engineering Analog and Digital Techniques			
Course Code:	**INPCC305**	**Credit**	**4**
Contact Hours:	3 Hrs/week (L) 1 Hr/week (T)	**Type of Course:**	Lecture/Tutorial
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Pre-requisites:

- Basic Electronics Engineering.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-Sem. Evaluation	Internal	40
2.	End Semester Examination	External	60

Course Objectives	
1	To explain the concept of basic characteristics, open loop & close loop configuration of operational amplifier (op-amp).
2	To describe the design aspect of different circuits using op-amp, timer and voltage regulator.
3	To discuss the functionality and applications of various digital circuits.
4	To impart skills to design combinational and sequential digital circuits.

Course Outcomes: Students will be able to	
305.1	Compare op-amp ICs on the basis of their characteristics and configurations and select ICs as per the application requirement.
305.2	Explain various linear and nonlinear analog circuits using general purpose op-amp ICs.
305.3	Explain analog circuits using special purpose ICs.
305.4	Explain working of various combinational logic circuits.
305.5	Describe the functioning of sequential logic circuits.
305.6	Compare the working of different counter circuits.

Topics covered:

UNIT I: Fundamentals of operational amplifier (6 hrs.)

Characteristics of operational amplifier, Comparative study of different amplifiers (OP07, LF353, and LM324). Introduction to open and closed Loop configurations of op-amp, Non-inverting amplifier, Inverting amplifier, Differential amplifier with feedback, Instrumentation amplifier: Equation of close loop gain, input impedance, output impedance and bandwidth.

UNIT II: Op-amp applications (6 hrs.)
Linear applications: Voltage summing and weighting circuit, Equation solving with op-amp, Practical Integrator, Practical differentiator, Current to voltage converter with zero and span adjustment circuit, Voltage to current converter with zero and span adjustment circuit
Non-linear applications: Comparator, Schmitt trigger, Barkhausen stability criteria, Wein bridge oscillator

UNIT III: Special purpose ICs (6 hrs.)
Timers: Astable, Monostable, and Bistable multivibrators using LM555.
Voltage regulators: Performance parameters (line regulation, load regulation, ripple rejection),
Fixed voltage regulators (IC78xx, IC79xx)

UNIT IV: Combinational Logic (6 hrs.)
Logic circuit minimization techniques: De-Morgan's Theorem, SOP form, POS form, Minimization
of SOP and POS forms, K-Maps.
Combinational Logic Circuits: Multiplexer, De-multiplexer, Encoder, Decoder, BCD to 7 segment decoder

UNIT V- Sequential Logic (6 hrs.)
Flip-flop: SR, JK, MSJK, D, T types of flip flop, Truth tables and excitation tables. Conversion from one type to another type of Flip Flop.

UNIT VI- Counters (6hrs.)
Asynchronous counters, Synchronous counters: Binary, Decade/BCD, Ring, Johnson counter, Shift register, Applications Digital clock, Digital display, Sequence Generator.

Syllabus contents required for competitive exams (GATE): Unit I, II, IV, V, VI

Text Books:

1. William D. Stanley, “Operational Amplifiers with Linear Integrated Circuits”, 4th Edition, Pearson Education India, 2002.
2. Ramakant Gaikwad, “Operational Amplifiers” PHI, 3 rd Edition, 1992.
3. D. Roy Choudhury, “Linear Integrated Circuits” New Age International, 4th Edition.
4. Floyd “Digital Principles”, Pearson Education, 11th Edition.
5. Gothman, “Digital Electronics”, 2nd Edition, PHI.
6. M. Morris Mano,’ Digital Design’, Pearson Education, 03rd Edition.

Reference Books:

1. Paul Horowitz, Winfield Hill, “The Art of Electronics”, 2 nd Edition, Cambridge University press, 2008.
2. Leach, Malvino, Saha; Digital Principles and Applications, 7th Edition, McGraw Hill.
3. R. P. Jain; Modern Digital Electronics, 4th Edition

Second Year Instrumentation Engineering Data Structure Lab			
Course Code:	**INESC307**	**Credit**	**1**
Contact Hours:	2 Hrs/week (P)	**Type of Course:**	Practical
Examination Scheme	Term Work 25 Marks		

Pre-requisites:

- Problem Solving and Programming II

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term Work	Internal	25

Course Objectives	
1	To explain different searching and sorting techniques
2	To describe various data structures, their operations.
3	To explain selection of data structure while programming.

Course Outcomes: Students will be able to	
307.1	Test various operations of Array, Matrix, List, Stack, Queue.
307.2	Apply searching and sorting algorithm in different applications.
307.3	Develope program code by selection of proper data structure using python language.
307.4	Solve real life problems using algorithms on various data structure.

List of Experiments:

Students are expected to perform any 8 experiments using python language.

1. Create a function of program written for unit conversion of temperature and pressure. Generate an array of values and use function developed for unit conversion using array operations.
2. Write a program for bubble sort.
3. Write a program for operation of 2 dimensional Arrays.4.Write a program for matrix operations.
5. Write a program to store marks of students in array. Write function for sorting array of in ascending order using a) Selection Sort b) Insertion sort c) Shell Sort d) Bucket sort e) Quick sort f) Radix sort and display top 10 scores.
6. Write program for various operations on Linked List
7. Write program for various operations on Stack

8. Write program for various operations on Ques
9. Write program for various operations on BAG

Text Books:

1. Rance D. Necaise, Data Structures and Algorithms Using Python by, John Wiley and Sons. ISSN: 9788126562169
2. Reema Thareja, "Python Programming Using Problem Solving Approach", Oxford University Press, ISBN 13: 978-0-19-948017-6.
3. R. Nageswara Rao, "Core Python Programming", Dreamtech Press; Second edition ISBN-10: 938605230X, ISBN-13: 978-9386052308 ASIN: B07BFSR3LL

References

1. Narasimha Karumanchi, Data Structures and Algorithms Made Easy, Career Monk Publications
2. Y Daniel Liang, "Introduction to Programming using Python", Pearson.
3. Benjamin Baka, David Julian, "Python Data Structures and Algorithms", Packt Publishers,2017

Second Year Instrumentation Engineering Electrical Measurements and Instrumentation Lab			
Course Code:	**INPCC308**	**Credit**	**1**
Contact Hours:	2 Hrs/week (P)	**Type of Course:**	Practical
Examination Scheme	Oral 25 Marks		

Pre-requisites:

- Basic knowledge of electrical engineering, laws, components, thevenin's theorem.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Oral	External	25

Course Objectives	
1	To introduce the different analog and digital instruments for measurement and procedure of measurement.
2	To explain the methodology of design of multirange ammeter, voltmeter and ohmmeter.

Course Outcomes: Students will be able to	
308.1	Calculate the values of resistances for design of multirange ammeter, voltmeter and ohmmeter
308.2	Determine the magnitude and frequency of given signal by CRO using Y-t, lissajous and Z-modulation techniques.
308.3	compute the resistance, inductance and capacitance by DC and AC bridges and use it as signal conditioning circuit for resistive, inductive and capacitive transducers.
308.4	demonstrate the application of ADCs and DACs to be used in digital instrumentation systems.
308.5	Explain the parts, applications and difference between analog indicating instruments and graphical recorders

List of Experiments:

1. Calibrate analog pressure gauge and prepare a calibration report.
2. Design multirange ammeter and voltmeter for minimum 3 different ranges.
3. Design series and shunt type ohmmeter.
4. Measurement of power using single phase wattmeter.
5. Measurement of voltage, current, time period, frequency and phase of sinusoidal wave using CRO
6. Measurement of unknown frequency by Z-modulation technique using CRO
7. Measurement of unknown resistance by wheatston's bridge.
8. Measure respective parameter by AC bridge (anyone AC bridge from syllabus).

9. To measure response time of a relay using DSO
10. To measure energy using single phase digital energy meter
11. Study and implementation of Analog to digital conversion using IC 0809
12. Study and implementation of Digital to Analog conversion using IC 0808
13. Design digital temperature measurement system using thermocouple/RTD
14. Study of y-t or X-Y recorder
Beyond syllabus
15. Apply wheatstone's bridge as a signal conditioning circuits for resistive sensors.
16. Measure the current using digital clamp meter.
17. Study and application of current and voltage transformer.

Text Books:

1. Sawhney A. K, "Electrical and Electronics Measurements and Instruments" Dhanpat Rai & Co. 02nd Ed
2. W. D. Cooper & A. D. Helfrick, "Electronic Instrumentation and Measurement Techniques" PHI, 4th e/d, 1987
3. David A.Bell," Electronic Instrumentation and Measurements", PHI, 2e/d

Reference Books:

1. Anand M. M. S., "Electronic Instruments and Instrumentation Technology", PHI, 2004, 02nd Ed.
2. Kalsi H. S., " Electronic Instrumentation", TMH, 2nd or 3rd e/d, 2004/2010.
3. R. Subburaj, "Calibration the Foundation for ISO 9000 and TQM".
4. Bouwens A. J., "Digital Instrumentation", McGraw-Hill, second edition.

Second Year Instrumentation Engineering Sensors and Transducers			
Course Code:	**INPCC309**	**Credit**	**1**
Contact Hours:	2 Hrs/week (P)	**Type of Course:**	Practical
Examination Scheme	Practical 50 Marks		

Pre-requisites:

- Basic knowledge of Electrical & Electronics Engineering.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Practical	External	50

Course Objectives	
1	To make students familiar with Sensors & its applications.
2	To discuss constructions and working principle of different types of sensors and transducers.
3	To make students aware about the construction, operation various features of sensors and transducers.
4	To familiar with different measuring instruments and the methods of measurement
5	To impart skills to evaluate the performance of methods of measurement and the use of different transducers.

Course Outcomes: Students will be able to	
309.1	Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc
309.2	Understand correctly the expected performance of various sensors
309.3	List and locate different type of sensors used in real life applications and paraphrase their importance
309.4	Outline and Use the concepts in common methods for converting a physical parameter into an electrical quantity.
309.5	Classify and explain with examples of transducers, including those for measurement of temperature, strain, motion, position and light

List of Experiments:

Students are expected to perform Minimum Eight Experiments :

1. Determine the characteristics of LVDT.
2. Study the characteristics of Load cell..
3. Compare performance of Orifice and Venture for flow measurement.
4. Evaluate performance characteristics of air purge method for level measurement.
5. Simulate the performance of a chemical sensor.
6. Characterization of RTD (PT100) for temperature measurement.
7. Characterize the temperature sensor (Thermocouple)
8. Calibration of pressure gauge using dead weight pressure tester.
9. Compare performance of encoder and tachometer for speed measurement.
10. Measurement of temperature and humidity using Arduino..
11. Water level measurement using Arduino..
12. Study on Temperature Measurement using Lab View.
13. Measurement of level in a tank using capacitive type level probe

Text Books:

1. Principle of Industrial Instrumentation by D. Patranabis, Tata McGraw Hill, 2nd Ed.
2. Instrumentation and Measurement Principles by . D.V.S. Murty, PHI, New Delhi, 2nd Ed.
3. Electrical and Electronics Measurement and Instrumentation by A.K. Sawhney,
   Dhanpat Rai & Co, 2nd Ed.
4. Process control instrumentation technology by Curtis D. Johnson, PHI learning Pvt. Ltd, 07th Ed.

Reference Books:

1. Measurement Systems by E.O. Doebelin, McGraw Hill, 06th Ed.
2. Process Measurement & Analysis by B.G. Liptak, CRC press, 04th Ed.
3. Instrumentation Devices and Systems by C. S. Rangan, G. R. Sharma and V. S. Mani, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 02nd Ed.
4. Mechanical and Industrial Measurements by R. K. Jain, Khanna Publishers, 02nd Ed.

Second Year Instrumentation Engineering
Analog and Digital Techniques Lab

Course Code:	**INPCC310**	**Credit**	**1**
Contact Hours:	2 Hrs/week (P)	**Type of Course:**	Practical
Examination Scheme	Practical 50 Marks		

Pre-requisites:

- Basic Electronics Engineering Lab

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Practical	External	50

Course Objectives	
1	To describe the design and implementation aspect of different analog circuits using op-amp, timer and voltage regulator ICs.
2	To describe various variable reduction techniques.
3	To explain the designing and testing of combinational and sequential digital circuits.

Course Outcomes: Students will be able to	
310.1	Apply the knowledge of characteristics of operational amplifier (op-amp) IC to select IC as per application.
310.2	Design and implement analog circuits using op-amp, IC555.
310.3	Apply various variable reduction techniques in the design of digital logic circuits.
310.4	Design and test digital circuits

List of Experiments:

(Any 3 from 1 to 5)

1. Bandwidth measurement of inverting and non- inverting amplifier.
2. Measurement and comparison of characteristics CMRR, slew rate, output offset voltage etc. using different op-amp ICs.
3. Design and implement differentiator. Plot the frequency response.
4. Design and implement wien bridge oscillator.
5. Design and implement comparator, zero crossing detector and schmitt trigger. Draw hysteresis plot.

(Any 1 from from 6 to 7)

6. Design and implement astable and monostable multivibrator using LM 555.
7. Design and implement fixed voltage regulator using 78xx.

(Any 2 from 8 to 13)

8. Design and Implement full adder and subtractor using logic gates.
9. Study of Flip –Flop ICs and conversion of flip –flop from one to other.
10. Implementation of counter of different Mod numbers.
11. Design of Sequential counter using type T and Type D design.
12. Design of Non sequential counter using type T and Type D design.

13. Design Ring & Johnson counters using shift register IC 7495.

(Any 2 from 14 to 16)

14. Interfacing of 7 segment LED display using IC 7447.
15. Implement an application using Multiplexer IC 74151.
16. Simulation/Implementation of Digital Clock using digital ICs.

Text Books:

1. William D. Stanley, "Operational Amplifiers with Linear Integrated Circuits", 4th Edition, Pearson Education India, 2002.
2. Ramakant Gaikwad, "Operational Amplifiers" PHI, 3 rd Edition, 1992.
3. D. Roy Choudhury, "Linear Integrated Circuits" New Age International, 4th Edition.
4. Floyd "Digital Principles", Pearson Education, 11th Edition.
5. Gothman, "Digital Electronics", 2nd Edition, PHI.
6. M. Morris Mano,' Digital Design', Pearson Education, 03rd Edition.

Reference Books:

1. Paul Horowitz, Winfield Hill, "The Art of Electronics", 2 nd Edition, Cambridge University press, 2008.
2. Leach, Malvino, Saha; Digital Principles and Applications, 7th Edition, McGraw Hill.
3. R. P. Jain; Modern Digital Electronics, 4th Edition, McGraw Hill.

Second Year Instrumentation Engineering
Vedic Mathematics

Course Code:	**INHSM311**	**Credit**	**1**
Contact Hours:	1 Hr/week (L)	**Type of Course:**	Lecture
Examination Scheme	Term-work 25 marks		

Pre-requisites:

- Vedic Sutras, Vedic Sub Sutras

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Assignment	Internal	25

Course Objectives	
1	To develop the understanding of Techniques/Sutras to solve mathematical arithmetic's in easy and faster way and use these techniques to varies Competitive Examinations.
2	To Improve speed and efficiency to solve even the most complex Mathematical problems.
3	To remove the phobia about mathematics in the minds of Students.
4	To help students to have better command over mathematical concepts and boost up their self- confidence level towards the subject.

Course Outcomes: Students will be able to	
311.1	ApplyVedic Mathematics techniques to Perform quickly and accurately mathematical calculations like multiplication, division, squares, cubes,LCM,HCF.
311.2	Apply Vedic Mathematics techniques to solve Linear Equations, Quadratic Equations, Factorization of a Cubic Polynomial.
311.3	Apply Vedic Mathematics techniques to Perform calculations in Coordinate Geometry, Differentiation, Integration and Trigonometry without relying heavily on calculators or written methods.

Topics covered:

Module I :- Basic Level(4Hrs)
Introduction of Vedic Mathematics, Multiplication, Square, Cube, Divisibility Test , Highest Common Factor of Polynomials, Multiplication of Polynomials, Division of Polynomials,

Module II: Intermediate Level(4Hrs)
Linear Equations, Quadratic Equations, Factorization of a Cubic Polynomial, Magic squares, Dates and Calendar.

Module III: Advance Level (4Hrs)
Determinant, Coordinate Geometry, Differentiation, Integration, Trigonometry.

Text Books:

1. Advanced Vedic Mathematics, Rajesh Kumar Thakur
2. Vedic Mathematics Made Easy , DhavalBathia
3. VEDIC MATHEMATICS ForStudents: LEVEL – 1 OF 5 SERIES, by Nava Vision

Reference Books:

1. Sri Bharatikrishna Tirthaji,"Vedic Mathematics", Published by Motilal Banarsidass, 1965.ISBN 81-208-0163-6.
2. Williams K.R. "Discover Vedic Mathematics" Vedic Mathematics Research Group, 1984.ISBN 1-869932-01-3.
3. Wiliams K.R. and M. Gaskell "The Cosmic Calculator". Motilal Banarsidass ,2002.ISBN 81-208-1871-7.
4. Nicholas A.P., Williams, J. Pickles." Vertically and Crosswise". Inspiration books, 1984.ISBN 1-902517-03-02

Second Year Instrumentation Engineering
Industrial Organization and Management

Course Code:	INHSM401	**Credit**	**2**
Contact Hours:	2 Hrs/week (L)	**Type of Course:**	Lecture
Examination Scheme	Term-work 25 Marks	Oral Examination 25 Marks	

Pre-requisites: Knowledge of Organization structure, Types and Management

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term work	Internal	25
2.	Oral Examination	External	25

Course Objectives	
1	To relate and the basic concept of industrial organization and management for instrumentation Project.
2	To learn and know the use of various standards in Industries to improve the quality .
3	To learn and understand the production planning and scheduling activities involved in industries.
4	To learn the procurement activities and vendor documents.
5	To get the knowledge of Finance and capital management.
6	To understand different ethics like business and professional and knowledge of e-business.

Course Outcomes: Students will be able to	
401.1	Evaluate the role and responsibilities organization.
401.2	Apply the documents / activities required for the quality.
401.3	Identify the tools of Planning and scheduling .
401.4	Classify the standards required for industry development .
401.5	Classify the different types of budget & implement the balance sheet.
401.6	Interpret the information related to business and professional ethics.

Topics covered:

Unit I: Basic Of Management & Strategic Industrial Management (4 hrs.)
Introduction, Definition of management, characteristics of management, functions of management - Planning, Organising, Staffing, Directing, Co-ordination, Controlling, Motivating, Communication, Decision Making.Strategic planning, types of business strategy, Business environment, SWOT analysis, Developing competitive advantage profile and Environmental, Threat and opportunity Profile.

Unit II: Quality , Health , Environment & Safety (4hrs.)
Quality Circles/Forums, Quality Objectives, use of Statistical Process control, Introduction to ISO 9000 and Role of R & D, Industry Institute Interaction, types of quality – quality of design, conformance and performance, phases of quality management .factors causing pollution, effect of pollution on human health, Air pollution control, sources of pollution water pollution and control, solid waste management Environmental norms: ISO 14000.

Unit III: Production Planning , Inventory Control (6 hrs.)

Manufacturing Excellence, Outsourcing, Production planning techniques, Purchase and Inventory Management, inventory control using Economic Order Quantity, Minimum Order Quantity, Ordering Level, store keeping, Finished goods, semi finished goods, raw material handling and storage, Value Addition, Supply Chain concepts and management for leveraging profit.

Unit IV:Human Resources Management (4 hrs.)

Manpower planning, Human Resources: exploiting true potential, Staff training and development, Motivation, Selection and training of manpower, Appraisal and increments management, Leadership skills, Delegation and development for growth. Objectives and Job Descriptions/ Role Summary.

Unit V:Financial Management (4 hrs.)

Capital Structure, Fixed & Working Capital, Sources of finance, Assets management, Introduction to capital budgeting, Methods of capital budgeting**:** Budget definition and concept, objective of budget, type of budget, preparation of budget, Balance Sheet, function of money market and capital Market.. .

Unit VI: Professional Ethics and e-Business (4 hrs.)

Concept of Ethics, ethics and morals, business ethics, Professional ethics. Need for professional and business ethics. Introduction to Management Information System (MIS), Enterprise Resource Planning Systems (ERP), e-business and strategies

Text Books:

1. Industrial organization and Engineering Economic- T. R. Banga and S. C. Sharma, Khanna Publication.
2. Industrial Engineering and Management- O.P. Khanna, Dhanpat Rai Publication.
3. P. Khanna, “Industrial Engineering and Management”, Dhanpatrai publications Ltd, New Delhi.
4.L.C.Shamba , Savitri Jhamb , Industrial Management – I , Everest Publishing House
Management in Engineering – Gail Freeman-Bell and James Balkwill (PHI).

Reference Books:

1. M.Y. Khan and P. K. Jain, “Financial Management”, Tata McGraw Hill, New Delhi
2. Davis and Margrethe H. Olson, "Management Information Systems", Mc-Graw-Hill International Editions
3.Management in Engineering- Gail Freeman- Bell and James Balkwill (P

Second Year Instrumentation Engineering
Control System and Components

Course Code:	**INBSC402**	**Credit**	**3**
Contact Hours:	3 Hrs/week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Pre-requisites: AC/DC Motor

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-Sem. Evaluation	Internal	40
2.	End Semester Examination	External	60

Course Objectives

1	To brief about electrical Components like switches, relays.
2	To Select suitable components for given application .
3	To study of different types of motor and application.
4	To study different components used in hydraulic system.
5	To study different components used in Pneumatic system.
6	To can build automation circuit using suitable components for application .

Course Outcomes: Students will be able to

402.1	Identify various switches, relays and contactors. .
402.2	Classify the different motors and its specification.
402.3	Develop electrical circuits for motor operations
402.4	Develop hydraulic circuits for the given application using appropriate hydraulic components
402.5	Develop pneumatic circuits for the given application using appropriate pneumatic components
402.6	Interpret the information related to safety measurement.

Topics covered:

UNIT I: INDUSTRIAL CONTROL DEVICES (6 hrs)

Switches:

Construction, symbolic representation, working, application of Toggle switch, Slide switch, DIP switch, Rotary switch, Thumb wheel switch, Selector switch, Push button, Limit switch, Temperature switch, Pressure switch, Level switch, Flow switch, emergency switch, Micro switches, Switch Specification

Relays:

Construction, working, specifications/selection criteria and applications of Electromagnetically relay, Reed relay, timing relay, Solid State Relay.

Contactors:

Construction, working, specifications and applications of contactors and their comparison with

relays.
Construction and working of rocker, drum switch, specifications of process switches, reed relay, solid state relays, problems on development of wiring diagram .

UNIT II: SPECIAL PURPOSE MOTORS (6 hrs)
Stepper Motor: Principle, types, terminology, half stepping and micro stepping techniques, characteristics, specification, applications.
Servomotors: Construction, working, features, advantages, disadvantages, characteristics of AC and DC servomotor, comparision with stepper motor. AC and DC position and speed Control.
DC Micro Motors: Types, Construction, working characteristics and application
Stepper Motor Control Circuits, Stepper motor interface with microcontroller.

UNIT III: MOTOR CONTROL CIRCUITS (6 hrs)
Electrical Wiring Diagram : Standard symbols used for electrical wiring diagram, sequencing and interlocking for motors, wiring diagram in relation to motor like starting , stopping, reversing direction of rotation, emergency shutdown, (Direct on line, star delta), breaking , starting with variable speeds, Jogging.VFD controller.
Mechanical Components : Springs (Compression, extension, flat , leaf and motor springs), gears
Protection of Motors : Short circuit protection, overload protection, low/under voltage protection , Phase reversal protection, over temperature protection.

UNIT IV: HYDRAULIC COMPONENTS (6 hrs)
Hydraulics: Principle, block diagram , advantages, disadvantages,application , hydraulic fluid properties.
Hydraulic Components : Hydraulic supply, Hydraulic pumps, Actuator (cylinder & motor), Hydraulic valves
Hydraulic Circuits: Development of hydraulic circuits using standard symbols, Different Hydraulic Circuits: Meter in, Meter out, Reciprocating, speed control, Sequencing of cylinders and Direction control.
Types of hydraulic oil, Selection, Hydraulic Components like Filter, piping, heat exchangers and motor.

UNIT V-PNEUMATIC COMPONENTS (6 hrs)
Comparison of Pneumatic, Hydraulic & Electrical systems.
Pneumatic components: Pneumatic Power Supply and its components ,Pneumatic relay ,Single acting & Double acting cylinder, direction controlled valves and flow control, FRL unit, Pneumatic actuator, pneumatic Valves.
Pneumatic Circuits Standard Symbols used for developing pneumatic circuits, Sequence diagram (step-displacement) for implementing pneumatic circuits, Different Pneumatic Circuits: Reciprocating, Sequencing, Direction control and Speed regulation. .

UNIT VI- AUXILIARY COMPONENTS & SAFETY MEASURES (6 hrs)
Auxiliary components:
Construction, working & applications of: Synchros (Transmitter and Receiver), Alarm annunciator, Square root extractor.
Safety Measures
Hazardous Area & Material classification as per NEC Standards, Explosion Proof Housing, Encapsulation, Sealing, & Immersion, Purging systems
Intrinsic Safety: Definition, designing for intrinsic Safety, Isolation or Encapsulation (Series & Shunt Protective elements & Zener barrier).

Text Books:

1. Industrial Electronics, Petruzella, McGraw-Hill, ISE Editions
2. Pneumatic Instrumentation, Majumdhar, TMH, 01st Edition
3. Industrial Hydraulics, Pipenger, McGraw-Hill Education, 3rd Edition
4. Process Control, Instrument Engineering Hand book, B.G. Liptak, Butterworth-Heinemann Ltd, Butterworth-Heinemann Ltd, 3rd Edition
5. MD Singh, K B Khanchandani, 'Power Electronics', , McGraw Hill Company, 2nd edition.
6.ANDREW PAAR , " Hydraulic and Pneumatic" A Technicians and Engg,. Guide.

Reference Books

1. Pneumatics, Festo Didactic
2. Hydraulics, Festo Didactic
3. Process control and Instrument technology, C.D.Johnson, TMH, 07th Ed.
4. P. C. Sen,' *Power Electronics'*, TMH, 2007, 02nd Ed.
5. Mohamad Rashid,' *Power Electronics'*, PHI, 2ndedition, 2004

Second Year Instrumentation Engineering Operating System			
Course Code:	**INESC403**	**Credit**	**3**
Contact Hours:	3 Hrs/week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Pre-requisites:

- Computer Peripherals, Digital System, C language

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-Sem. Evaluation	Internal	40
2.	End Semester Examination	External	60

Course Objectives	
1	To introduce basic concepts and functions of modern operating system
2	To provide better understanding of functions of different operating systems.
3	To provide knowledge of software testing and communication protocols
4	To understand the software development life cycle.

Course Outcomes: Students will be able to	
403.1	Compare the different operating system based on their functioning; identify the real time operating system, parallel computer systems
403.2	Elaborate the memory management concept in operating systems, paging algorithms and file systems.
403.3	Discuss pre-emptive and non-pre-emptive scheduling algorithm, concept of process scheduling algorithms
403.4	Explain various communication protocols in networking.
403.5	Design and conduct a software test process for a software testing project.
403.6	Discuss software development life cycle and its model.

Topics covered:

Unit I: Fundamentals of Operating System (6hrs)
Concepts of Operating System and its services, Types of operating systems Process Management: Concept, scheduling, operations on process CPU scheduling: Basic concepts, CPU scheduling algorithms Deadlocks: Characterization, Handling, Recovery Disk scheduling algorithms

Unit II: Memory and File systems (6hrs) Memory Management: Address Binding, Overlays, Swapping, Contiguous memory allocation, Paging, Segmentation Virtual memory: Concept, Demand paging, Page size considerations, Page replacement algorithms, Thrashing File system management: Concept, file access methods, directory structures, file allocation methods.
Unit III: Real Time Operating Systems and Parallel Computers (6hrs) Real Time & embedded System OS: Concepts, Types, their differences, Handheld Operating Systems. Interrupt Routines in RTOS environment, RTOS Tasks and their Scheduling models, Strategy for synchronization between the processes, Parallel Computers: Basic concepts, Types of parallelism, Inter task dependencies, classification of parallel computers, vector computers, Array processors, Systolic Arrays.
Unit IV: Communication Protocols (6hrs) Computer Communication: ISO-OSI Seven Layer model, The TCP/IP reference model Introduction to LAN, LAN topologies, IEEE standards for networking- IEEE 802.3, IEEE 802.4, IEEE 802.5, CAN bus, MODBUS , Profibus.
Unit V: Software Testing & Software Development Life Cycle (6hrs) Software Testing techniques, CASE tools Software debugging: Software Development Life Cycle and its models. Case study of advance tools in software testing and design : Jira, Agile, Selenium Libraries, Maven- Build. Automation Tool, create test cases, scripts.
Unit VI: Case Study : Web Development Life Cycle (6hrs) Layers of Web Development, Systems Analysis and Design, Web Application Development, Web Development Life Cycle stages
GATE Questions: UNIT 1,2,3,4

Text Books:

1. Operating System Concepts by Silberschatz, Galvin, Gagne
2. Parallel Computer architecture and programming by V. Rajaraman, C. SivaRam Murthy, PHI
3. Computer Networks by Andrew Tanenbaum, Prentice Hall.
4. Introduction To Data Compression by Khalid Sayood, Morgan Kaufmann Publishers, Inc.
5. Software Engineering by Ian Somerville, 4th edition, Addison Wesley publication

Reference Books:

1. Computer Architecture and Parallel processing by Kai Hwang, Faye Briggs, McGraw Hill International Editions
2. Computer Networks Protocols, Standards and Interfaces by Uyless Black, PHI
3. High Speed Networks TCP/IP and ATM design principles by William Stallings.
4. Introduction To Data Compression by Khalid Sayood, Morgan Kaufmann Publishers, Inc.

Second Year Instrumentation Engineering Process Control Loop Components			
Course Code:	**INPCC404**	**Credit**	**3**
Contact Hours:	3 Hrs/week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Pre-requisites:

- Basic knowledge of sensors//transducers, control system, Linear Integrated Circuits.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-Sem. Evaluation	Internal	40
2.	End Semester Examination	External	60

Course Objectives	
1	To introduce basic fundamentals of automation.
2	To explain construction and working of transmitter, controller and control valve of process control loop.
3	To demonstrate the application of PID controller for pressure control loop and tuning methods.

Course Outcomes: Students will be able to	
404.1	draw temperature, pressure, flow and level process control loop using standard components symbols by studying process characteristics and list process variables associated with loop.
404.2	demonstrate the application of DPT for flow and level measurement.
404.3	apply suitable control law to regulate the controlled variable at its set point value
404.4	calculate PID parameters' tuning values by applying Z-N open loop and closed loop method to satisfy 1/4 th decay ratio tuning criteria
404.5	determine control valve coefficient and control valve size for different control valve characteristics.
404.6	explain causes of cavitation and flashing in different types of valves, its effects and remedies.

Topics covered:

UNIT I: FUNDAMENTALS OF PROCESS CONTROL (08 hrs)

Components of process control loop, Examples of process loops like temperature, flow, level, pressure etc., concept of process variables, Signal line symbols, instrument symbols as per location, concept of field area and control room area, standard signals and its need, concept of live and dead zero.

Process Characteristics: Process equation, capacity, self – regulation, control lag, process lag, distance/velocity lag (dead time).

UNIT II: TRANSMITTER (06 hrs)

Need of transmitter, two and four wire transmitters, features of transmitter.

Electronic Capacitive Differential Pressure Transmitter: installation (impulse pipe and manifold), calibration setup, application of DPT for level and flow measurement, zero elevation and suppression.

SMART: Comparison with conventional transmitter, block schematic, specifications.

UNIT III: CONTROLLER PRINCIPLES (06 hrs)

Control system parameters: Error, variable range, cycling, direct/reverse action.

Discontinuous: two position, multi-position and floating control modes.

Continuous: Proportional, integral, derivative, proportional-integral, proportional- derivative, proportional- integral-derivative (PID) control modes, reset windup, rate before reset, bump less transfer.

UNIT IV: TUNING OF PID CONTROLLER (04 hrs)

Tuning of controller: Different criteria like Quarter amplitude decay ratio, Integral time performance indices.

Tuning Methods: Process reaction curve (open loop), Ziegler Nichols (closed loop)

UNIT V: CONTROL VALVES PART-I (06 hrs)

Converters: Current to pressure converter, pressure to current converter.

Necessity of final control elements, Control valve parts, Actuators (Pneumatic, Electric, Hydraulic and handwheel), Control valve classification. Control valve terminology: Rangeability, turndown, viscosity index, valve capacity, AO, AC, fail-safe actions. Control valve characteristics: Inherent and installed. Control valve sizing coefficient CV.

UNIT VI: CONTROL VALVE PART-II (06 hrs)

Linear valve: Globe valve (GV): constructions, working, advantages, disadvantages and applications, Single seated GV, double seated GV, 3-way GV, Gate valve, angle valve. **Rotary valve**: Butterfly valve, Ball valve

Positioner: Need, effect on performance of control valve

Cavitation, flashing and noise, their effects and remedies

Text Books:

1. C. D. Johnson, “Process control and Instrument technology” Tata McGraw Hill, Publications, 08th Ed.
2. N.A. Anderson, Boca Ratan, “Instrumentation for Process measurement and control, Radnor Pennsylvania, CRC Press, 03rd Ed.

Reference Books:

1. B. G. Liptak, “Process Control, Instrument Engineering Hand book CRC Press, 03rd Ed.
2. Tuning of industrial control systems, ISA.
3. Control valve Handbook, ISA

Second Year Instrumentation Engineering Signals and Systems			
Course Code:	**INESC405**	**Credit**	**3**
Contact Hours:	3 Hrs/week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Pre-requisites:
Engineering Mathematics-I , Engineering Mathematics-II.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-Sem. Evaluation	Internal	40
2.	End Semester Examination	External	60

Course Objectives	
1	Understand the mathematical representation of continuous and discrete time signals and systems.
2	Classify signals and systems into different categories.
3	Analyze Linear Time Invariant (LTI) systems in time and transform domains.
4	Interplay between the time and frequency domain
5	Apply the appropriate transform to solve the CT and DT signals.

Course Outcomes: Students will be able to	
405.1	Identify the basic signals and perform operations on signals.
405.2	Classify the systems based on their properties.
405.3	Apply the Fourier series and Fourier transform to the periodic and aperiodic signals.
405.4	Apply the Laplace and Z - transform to analyze signals.
405.5	Make use of different transforms in signal processing
405.6	Demonstrate the relationship between time and frequency domain

Topics covered:

Unit I: Fundamentals of Signals & Systems (6 hrs)
Signals: Continuous and discrete time signal representation, Operations on CT and DT signals : Classification of signals:
Systems: static and dynamic systems, causal and non-causal systems, Linear and Non- linear systems, time variant and time invariant systems, stable and unstable systems, invertible and non-

invertible systems
Unit II: Behavior of LTI System in Time and frequency domain (6 hrs) **Continuous Time LTI and discrete time LTI system and its properties. Frequency response of LTI system,** Input-output relation, impulse response, convolution sum, convolution integral, linear convolution, circular convolution, Correlation. Frequency response of first and second-order linear time-invariant systems.
Unit III: Fourier Series (6 hrs) Fourier series representation in CT and DT domain, Properties of CTFS and DTFS, Gibbs phenomenon, symmetry properties, magnitude and frequency plot.
Unit III: Fourier Transform (6 hrs) **Representation of CTFT and DTFT,** Properties of CTFT and DTFT, DFT and IDFT, FFT Radix 2 decimation in time, Sampling theorem
Unit IV: Application of Z-transform (6 hrs) Z transform and its properties, transfer function, pole zero plot, region of convergence, stability and causality, inverse z transform.
Unit V: Application of Laplace Transform (6 hrs) Laplace Transform (LT), Properties of ROC, Laplace transform of standard periodic and aperiodic functions, properties of Laplace transform, Inverse Laplace transforms, stability. Application of Laplace transforms.
GATE syllabus : **Unit: I,II,III,IIV,V,VI**

Text Books:

1. Simon Haykins and Barry Van Veen, “Signals and Systems”, Wiley India, 2 nd Edition.
2. M.J. Roberts “Signal and Systems”, Tata McGraw Hill 2007

Reference Books:

1. Charles Phillips, “Signals, Systems and Transforms”, Pearson Education, 3 rd Edition.
2. Peyton Peebles, “Probability, Random Variable, Random Processes”, Tata Mc Graw Hill, 4 th Edition.
3. A. Nagoor Kanni “Signals and Systems”, Mc Graw Hill, 2 nd Edition.

Second Year Instrumentation Engineering Virtual Instrumentation Lab			
Course Code:	**INPCC407**	**Credit**	**1**
Contact Hours:	2 Hrs/week (P)	**Type of Course:**	Practical
Examination Scheme	Term-work 25 Marks		

Pre-requisites:

- Problem Solving and Programming II.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term Work	Internal	25

Course Objectives	
1	To explain the concept of basic operations in Labview
2	To describe the design aspect of loop in Labview.
3	To describe hardware and software interfacing in LabView

Course Outcomes: Students will be able to	
407.1	Understanding Virtual Instrument concepts.
407.2	Develop program for specific application using Virtual Instrument software
407.3	To acquire, analyze and display the throughput of any compatible system.
407.4	Interface hardware and software using Virtual Instrument

List of Experiments:

Students are expected to perform Minimum Eight Experiments :

1. Introduction to VI, Basic Operations, Controls, Indicators and Structures.
2. To perform basic Arithmetic Operations using VI.
3. Loops and case structure
4. To perform convolution of two signals using VI.
5. Generate signals such as Sine, Square, and Triangular using VI.
6. Creating Sub VIs and Its usage in High Level Applications
7. Data Acquisition in VI –using USB 6001 hardware
8. File IO , Data saving
9. Study of MyRio in VI – Basic introduction
10. Acquire, analyze and present physical signal using virtual instrumentation
11. Troubleshooting and debugging technique
12. State machine architecture

Text Books:

1. Robert H Bishop "Learning with LabVIEWs" Prentice Hall,2003
2. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newnes, 2000.
3. Rick Bitter, LabVIEW advanced programming technique, 2nd Edition, CRC Press, 2005
4. Jovitha Jerome, Virtual Instrumentation using LabVIEW, 1st Edition, PHI, 2001.
5. Gary J Johnson, Richard Jennings, "Lab-VIEW Graphical programming" McGraw Hill 2001

Second Year Instrumentation Engineering Process Control Loop Components Lab			
Course Code:	**INPCC408**	**Credit**	**1**
Contact Hours:	2 Hrs/week (P)	**Type of Course:**	Practical
Examination Scheme	Practical examination 50 Marks		

Pre-requisites:

- Basic knowledge of sensors//transducers, control system, Linear Integrated Circuits.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Practical	External	50

Course Objectives	
1	To explain the process control loop, component symbols and process variables.
2	To introduce workings and applications of the transmitter, controller, converter and final control element.

Course Outcomes: Students will be able to	
408.1	demonstrate the application of DPT for Flow and level measurement.
408.2	explain the procedure of calibration of DPT and converters.
408.3	implement the circuit for on-off controller.
408.4	describe effects of control actions for pressure control loop.
408.5	demonstrate the Z-N closed loop tuning method to tune PID parameters

List of Experiments:

Students are required to perform minimum 08 experiments from the given list.

1. Measurement of flow rate with DPT.
2. Measurement of level using DPT.
3. Calibrate Differential pressure transmitter.
4. Calibrate I to P converter and plot its input-output response.
5. Calibrate P to I converter and plot its input-output response.
6. Implement the On-Off controller circuit.
7. Verify the effect of different proportional controller gain for pressure control loop.
8. Verify the effect of proportional- integral controller for pressure control loop.
9. Tune the controller for temperature/pressure control loop using Z-N closed loop method.
10. Tune the controller for level/flow control loop using Z-N closed loop method.
11. Study various parts of control valve and plot the quick opening, linear and equal percentage type installed characteristics.

Text Books:

1. C. D. Johnson, "Process control and Instrument technology" Tata McGraw Hill, Publications, 08th Ed.
2. N.A. Anderson, Boca Ratan, " Instrumentation for Process measurement and control, Radnor Pennsylvania, CRC Press, 03rd Ed.

Reference Books:

1. B. G. Liptak, "Process Control, Instrument Engineering Hand book CRC Press, 03rd Ed.
2. Tuning of industrial control systems, ISA.
3. Control valve Handbook, ISA

Second Year Instrumentation Engineering
PLC and SCADA Programming Lab

Course Code:	**INPCC409**	**Credit**	**2**
Contact Hours:	1 Hrs/week (L) 2 Hrs/week (L)	**Type of Course:**	Practical
Examination Scheme	Term-work 25 Marks		

Pre-requisites:

- Sensors, Transducers, Transmitters, Process Loop Elements, Process Loop Components.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term-work	Internal	25

Course Objectives	
1	This course is designed to expose students to understand the process automation concepts like programmable logic controller, SCADA, HMI and Project.

Course Outcomes: Students will be able to	
409.1	To describe the basics of PLC and Ladder diagram programming language
409.2	To explain the basics of SCADA and different SCADA/HMI software available.
409.3	To apply the knowledge of basics of ladder diagram to solve various instrumentation problems.
409.4	To design SCADA PLC based systems for process control application.
409.5	To design SCADA PLC based systems for process control application.

List of Experiments: Students are expected to perform minimum eight experiments.

1. Study of Programmable Logic Controller (PLC)
2. Develop and simulate Logic gates
3. Develop the Ladder Logic to start the pump
4. Develop the Ladder Logic Programming for sequencing Develop the Ladder Logic Programming for Interlock
5. Study of the Timers in PLC
6. Study of Counters in PLC

7. Develop a ladder logic for Timer and counter based application.
8. Develop the Ladder Logic Programming for DOL starter using start and stop Push button
9. Study of SCADA
10. Implementation of the SCADA application for simple discrete automation.
11. Implementation of the SCADA application for the process Automation.

Text Books:

1. Programmable Logic Controllers: Principles & Applications by John W. Webb, Ronald A. Reis, Prentice Hall of India, 5th ed.
2. Introduction to Programmable Logic Controllers by Gary Dunning, Delmar Thomson Learning, 3rd ed.
3. Programmable Logic Controllers: Programming methods and applications by John R. Hackworth and Frederick D. Hackworth Jr., Pearson publication

Reference Books:

4. Programmable Logic Controller by Frank D Petruzella, McGraw-Hill Education, 5thed.
5. Programmable Logic Controllers by W. Bolton, Elsevier Newness publication, 4th ed.
6. Programmable Controller by T. A. Huges, ISA publication, 2nd ed.
7. SCADA by Stuart A. Boyer, ISA 1999.

Second Year Instrumentation Engineering Project Based Learning Lab			
Course Code:	**INPRO410**	**Credit**	**1**
Contact Hours:	2 Hrs/week (P)	**Type of Course:**	Practical
Examination Scheme	Term-work 50 Marks		

Pre-requisites:

- Analog and Digital Techniques
- Data Structure

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term-work	Internal	50

Course Objectives	
1	To work on different issues in society
2	To design the prototype
3	To develop a software based framework.

Course Outcomes: Students will be able to	
410.1	Use different electronic components and sensors/transducers to provide practical solution to real life problems.
410.2	Design/model/simulate/and fabricate a prototype
410.3	Designing and implementation of mini project which includes measurement of parameter signal processing, controlling, debugging related to objectives defined in the problem statement.
410.4	Prepare the project report

List of Experiments:

Phase 1:

1. Topic Selection: To discuss the shortlisted topic(s) for the batch
2. Group Formation: Proposal of shortlisted idea and identification of like-minded students (*up to 4 members*) as a team

Phase 2:

1. Proposal of various probable solutions/approaches to the problem
2. Brain storming on the probable solutions
3. Selection of a feasible solution
4. Bill of Materials (BOM)
5. Assigning the tasks and roles starting with literature survey

Phase 3:

1. Review of Literature Survey: Identification of Gaps
2. Formulation of Problem Statement

3. Defining Objectives, Materials and Methods
4. Proposal of Budget
5. Designing PERT Chart [*program evaluation and review technique*]

Phase 4:

1. Probable Design, Drawing, Simulation and Design Of Experiment

Phase 5:

1. Review of progress
2. Presentation to review panel

Phase 6:

1. Identification of materials/ supporting software/ hardware/ components
2. Proposal of budget, if any

Phase 7:

1. Implementation of Experiment
2. Programming / Fabrication / Poster / Model

Phase 8:

1. Testing of experimental design (Fabrication/Program/Poster) to satisfy the aims and objectives followed by analysis and identification of changes to be made in line with aims and objectives

Phase 9:

1. Testing of experimental design (Fabrication/Program/Poster) to satisfy the aims and objectives followed by analysis and identification of changes to be made in line with aims and objectives
2. Compilation of observations
3. Reporting of results and discussions over the results

Phase 10:

1. Verification of results with reference to proposed expected outcome and providing logical explanation citing evidences to support the results obtained
2. Discussion of results and philosophy behind logical explanation citing reported results and evidences, if any.
3. Reporting the findings to compile report with the help of literature referred
4. In case of novelty of results; developing scientific mechanism and logical reasoning to establish validity of the results

Phase 11:

1. Review of progress
2. Presentation of results in the form of report
3. Validation of report and certification of authenticity for the study done
4. Promoting students to exhibit model based on implementable solution of study undertaken
5. Participation of students in intercollegiate competition(s)

Phase 12:

1. Submission of the project report along with supporting model / poster / paper / documents

Second Year Instrumentation Engineering Sustainable Development Goals			
Course Code:	**INHSM411**	**Credit**	**1**
Contact Hours:	1 Hr/week (L)	**Type of Course:**	Lecture
Examination Scheme	Term-work 25 marks		

Pre-requisites:

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	**Home Assignment / MCQ**	Internal	25

Course Objectives	
1	To discuss the sustainable development goals.
2	To explain frame work of Seventeen Sustainable Development Goals.
3	To discuss structure and order of Sustainable Development Goals.
4	To study cases of Sustainable Development Goals.

Course Outcomes: Students will be able to	
411.1	Explain sustainable development goals.
411.2	Describe framework of Seventeen Sustainable Development Goals.
411.3	Discuss structure and order of Sustainable Development Goals.
411.4	Report case studies of Sustainable Development Goals

Topics covered:

Unit 1: Introduction to SDGs (3 hrs)

Sustainability, Sustainable development, Role of UN and the Need for SDGs, Scope and Inclusion and Agenda 2030, Our Common Future and Philosophy behind SDGs, Distinction between Development and Sustainable Development

Unit 2: Sustainable Development Goals (5 hrs)

Framework and Structuring of Seventeen SDGs
SDG 1: No Poverty
SDG 2: Zero Hunger
SDG 3: Good Health and Well-being
SDG 4: Quality Education
SDG 5: Gender Equality
SDG 6: Clean Water and Sanitation

SDG 7: Affordable and Clean Energy
SDG 8: Decent Work and Economic Growth
SDG 9: Industry, Innovation and Infrastructure
SDG 10: Reduced Inequality
SDG 11: Sustainable Cities and Communities
SDG 12: Responsible Consumption and Production
SDG 13: Climate Action
SDG 14: Life Below Water
SDG 15: Life on Land
SDG 16: Peace and Justice Strong Institutions
SDG 17: Partnerships to achieve the Goal

Unit 3: SDG Structure and Order (3 hrs)
Interrelationships and Connections between Seventeen SDGs, SDG Structure and Order at Levels of People, Ecological and Spiritual , SDGs and Socio Ecological Systems: Economy; Society; Biosphere

Unit 4: Sustainable Development Goals- Case Studies (2 hrs)
Case Studies from around the World, Case studies from India

Text Books:

1. Hazra, Somnath., Bhukta, Anindya (2020) Sustainable Development Goals An Indian Perspective, Springer International Publishing, Switzerland
2. Ziai, Aram (2016) Development Discourse and Global History from colonialism to the sustainable development goals. Routledge, London & New York
3. OECD (2019), Sustainable Results in Development: Using the SDGs for Shared Results and Impact, OECD Publishing, Paris, https://doi.org/10.1787/368cf8b4-en.
4. Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G., Fuller, G., Woelm, F. 2020. The Sustainable Development Goals and COVID-19. Sustainable Development Report 2020. Cambridge: Cambridge University Press.

Relevant websites, movies, and documentaries

https://www.un.org/sustainabledevelopment/

Second Year Instrumentation Engineering
Sensors and Transducers

Course Code:	**INMNR301**	**Credit**	**3**
Contact Hours:	3 Hrs/week (L)	**Type of Course:**	Lecture
Examination Scheme		End-sem. Examination 75 Marks	

Pre-requisites: Basic knowledge of Electrical & Electronics Engineering

Course assessment methods/tools:

Sr. No.		Course assessment methods/tools	External/ Internal	Marks
1.		End Semester Examination	External	75

Course Objectives	
1	To make students familiar with Sensors & its applications.
2	To discuss constructions and working principle of different types of sensors and transducers.
3	To make students aware about the construction, operation various features of sensors and transducers.
4	To familiar with different measuring instruments and the methods of measurement
5	To impart skills to evaluate the performance of methods of measurement and the use of different transducers.

Course Outcomes: Students will be able to	
INMNR301.1	Understand correctly the expected performance of various sensors and its application
INMNR301.2	Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like level, pressure, flow, acceleration, etc
INMNR301.3	List and locate different type of sensors used in real life applications and paraphrase their importance
INMNR301.4	Outline and Use the concepts in common methods for converting a physical parameter into an electrical quantity.
INMNR301.5	Classify and explain with examples of transducers, including those for measurement of temperature, strain, motion, position and light

Topics covered:

Unit I: DISPLACEMENT, FORCE AND SPEED MEASUREMENT (6 hrs.)

Need of sensors and transducers, transducers definition, classification, performance characteristics and selection criteria.

Displacement Measurement: resistive-potentiometers, inductive-LVDT and RVDT,capacitive, piezoelectric, ultrasonic and proximity sensors.

Force transducer: Basic methods of force measurement, Elastic force transducer, Load cell, LVDT

Speed Measurement: Tachometer, Magnetic pickups, Encoders, Photoelectric pickups,

Unit II: LEVEL MEASUREMENT (6hrs.)

Level Measurement: Dipstick displacer, float, Bubblers method, Diaphragm level detector, laser level sensor, time domain reflectometry, ultrasonic level detector.

Unit III: PRESSURE MEASUREMENT (6 hrs.)

Pressure scales and standards, Types of Pressure: Gauge pressure, Absolute pressure, Differential pressure, Vacuum pressure

Types of Pressure sensor: Dead weight tester, vacuum pressure sensor, Bourdon tube , Manometers

Elastic Pressure sensor: Bellows, bourdon tubes, diaphragm.

Unit IV: Temperature measurement (6 hrs.)

Temperature scales, classification,

Thermometer- types of thermometer, filled system thermometer,

RTD-Material used, types 2 wire,3 wire & 4 wire, application of RTD,

Thermistor –Material used, type (NTC , PTC) and it's application.

Thermocouples- Material used, Types(A,B,C,D,E,J,K,R,S,T), laws of thermocouples, cold junction compensation method.

Semiconductor temperature sensors- Diode & IC temperature sensor LM35.

Unit V: FLOW MEASUREMENT (6 hrs.)

Units, Classification of flow: Newtonian and non-Newtonian fluids, Reynolds's number, laminar and turbulent flows, velocity profile, Bernoulli's equation for incompressible flow, head type flow meters (orifice, venture meter and pitot tube), variable area type, turbine, electromagnetic , ultrasonic, vortex shedding, anemometers , mass flow meter: Coriolis flow meter.

Text Books:

1. Principle of Industrial Instrumentation by D. Patranabis, Tata McGraw Hill, 2nd Ed.
2. Instrumentation and Measurement Principles by . D.V.S. Murty, PHI, New Delhi, 2nd Ed.
3. Electrical and Electronics Measurement and Instrumentation by A.K. Sawhney, Dhanpat Rai & Co, 2nd Ed.
4. Process control instrumentation technology by Curtis D. Johnson, PHI learning Pvt. Ltd, 07th Ed.

References

1. Measurement Systems by E.O. Doebelin, McGraw Hill, 06th Ed.
2. Process Measurement & Analysis by B.G. Liptak, CRC press, 04th Ed.
3. Instrumentation Devices and Systems by C. S. Rangan, G. R. Sharma and V. S. Mani, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 02nd Ed.
4. Mechanical and Industrial Measurements by R. K. Jain, Khanna Publishers, 02nd Ed.

Second Year Instrumentation Engineering
Sensor and Transducers Lab

Course Code:	**INMNR302**	**Credit**	**1**
Contact Hours:	2 Hrs/week (P)	**Type of Course:**	Practical
Examination Scheme	Term Work 25 Marks		

Pre-requisites:

- Basic knowledge of Electrical & Electronics Engineering

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Practical	Internal	25

Course Objectives	
1	To explain different characteristics techniques of Transducers
2	To describe various performance of flow measurements.
3	To explain selection of methods for level measurement.
4	To make students aware about the simulation operation of various features of sensors
5	To familiar with different temperature measuring instruments and methods
6	To impart skills on the performance of arduino and labview methods of measurement

Course Outcomes: Students will be able to	
INMNR302.1	Test various characteristics operations of LVDT and Load cell.
INMNR302.2	Understand different applications of flow measurement.
INMNR302.3	Develope program code by selection of proper data structure using python language.
INMNR302.4	Solve through software simulation on various characteristics of sensor.
INMNR302.5	Identify the proper methods and instrument for temperature measurement
INMNR302.6	Understand the working on different open source and virtual instrument platform

List of Experiments:

Students are expected to perform any 8 experiments using python language.

1. Determine the characteristics of LVDT.
2. Study the characteristics of Load cell..
3Compare performance of Orifice and Venture for flow measurement..
4. Evaluate performance characteristics of air purge method for level measurement.
5. Simulate the performance of a chemical sensor.
6. Characterization of RTD (PT100) for temperature measurement.
7. Characterize the temperature sensor (Thermocouple)
8. Calibration of pressure gauge using dead weight pressure tester.

9. Compare performance of encoder and tachometer for speed measurement.

10. Measurement of temperature and humidity using Arduino..
11. Water level measurement using Arduino..

AISSMS Institute of Information Technology, Pune

12. Study on Temperature Measurement using Lab View.
13. Measurement of level in a tank using capacitive type level probe

Text Books:

1. Principle of Industrial Instrumentation by D. Patranabis, Tata McGraw Hill, 2nd Ed.
2. Instrumentation and Measurement Principles by . D.V.S. Murty, PHI, New Delhi, 2nd Ed.
3. Electrical and Electronics Measurement and Instrumentation by A.K. Sawhney, Dhanpat Rai & Co, 2nd Ed.
4. Process control instrumentation technology by Curtis D. Johnson, PHI learning Pvt. Ltd, 07th Ed.

References

1. Measurement Systems by E.O. Doebelin, McGraw Hill, 06th Ed.
2. Process Measurement & Analysis by B.G. Liptak, CRC press, 04th Ed.
3. Instrumentation Devices and Systems by C. S. Rangan, G. R. Sharma and V. S. Mani, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 02nd Ed.
4. Mechanical and Industrial Measurements by R. K. Jain, Khanna Publishers, 02nd Ed.

Second Year Instrumentation Engineering Process Control Loop Components			
CourseCode:	**INMNR401**	**Credit**	**3**
ContactHours:	3Hrs/week (Th)	**Type of Course:**	Lecture
Examination Scheme		Endsem.Examination 75Marks	

Pre-requisites:

- Basicknowledge of sensors//transducers, control system, Linear Integrated Circuits.

Sr.No.	Courseassessmentmethods/tools	External/Internal	Marks
1.	EndSemester Examination	External	75

Course Objectives	
1	To introduce basic fundamentals of automation.
2	To explain construction and working of transmitter, controller and control valve of process control loop.
3	To demonstrate the application of PID controller for pressure control loop and tuning methods.

CourseOutcomes: Studentswillbeableto	
INMNR401.1	draw temperature, pressure, flow and level process control loop using standard components symbols by studying process characteristics and list process variables associated with loop.
INMNR401.2	demonstrate the application of DPT for flow and level measurement.
INMNR401.3	apply suitable control law to regulate the controlled variable at its set point value
INMNR401.4	calculate PID parameters' tuning values by applying Z-N open loop and closed loop method to satisfy 1/4 th decay ratio tuning criteria
INMNR401.5	determine control valve coefficient and control valve size for different control valve characteristics.
INMNR401.6	explain causes of cavitation and flashing in different types of valves, its effects and remedies.

UNIT I: FUNDAMENTALS OF PROCESS CONTROL (10 Hrs)

Components of process control loop, Examples of process loops like temperature, flow, level, pressure etc., concept of process variables,Signal line symbols, instrument symbols as per location, concept of field area and control room area, standard signals and its need, concept of live and dead zero.

Process Characteristics: Process equation, capacity, self – regulation, control lag,process lag, distance/velocity lag (dead time).

UNIT II: TRANSMITTER (06 Hrs)

Need of transmitter, two and four wire transmitters, features of transmitter.

Electronic Capacitive Differential Pressure Transmitter: installation (impulse pipe and manifold), calibration setup, application of DPT for level and flow measurement, zero elevation and suppression.
SMART: Comparison with conventional transmitter, block schematic, specifications.

UNIT III: CONTROLLER PRINCIPLES (08 Hrs)

Control system parameters: Error, variable range, cycling, direct/reverse action.
Discontinuous: two position, multi-position and floating control modes.
Continuous: Proportional, integral, derivative, proportional-integral, proportional-derivative,proportional- integral-derivative (PID) control modes, reset windup, rate before reset,bump less transfer.

UNIT IV: TUNING OF PID CONTROLLER (05 Hrs)

Tuning of controller: Different criteria like Quarter amplitude decay ratio, Integral time performance indices.
Tuning Methods: Process reaction curve (open loop), Ziegler Nichols (closed loop)

UNIT V: CONTROL VALVES (08 Hrs)

Converters: Current to pressure converter,pressure to current converter.
Necessity of final control elements, Control valve parts, Actuators (Pneumatic, Electric, Hydraulic and handwheel), Control valve classification. Control valve terminology: Rangeability, turndown, viscosity index, valve capacity, AO, AC, fail-safe actions. Control valve characteristics: Inherent and installed. Control valve sizing coefficient CV, Linear valve: Globe, 3-way globe, Gate valve; Rotary valve: Butterfly and ball valve

TextBooks:

1. C. D. Johnson, “Process control and Instrument technology”Tata McGraw Hill, Publications, 08th Ed.
2. N.A. Anderson, Boca Ratan, “ Instrumentation for Process measurement and control, Radnor Pennsylvania, CRC Press, 03rd Ed.

ReferenceBooks:

1. B. G. Liptak, “Process Control, Instrument Engineering Hand book CRC Press, 03rd Ed.
2. Tuning of industrial control systems, ISA.
3. Control valve Handbook, ISA

Second Year Instrumentation Engineering
Process Control Loop Components Lab

Course Code:	**INMNR402**	**Credit**	**1**
Contact Hours:	2Hrs/week (L)	**Type of Course:**	Practical
Examination Scheme	Termwork examination 25 Marks		

Pre-requisites:

- Basicknowledge of sensors//transducers, control system, Linear Integrated Circuits.

Sr.No.	Courseassessmentmethods/tools	External/Internal	Marks
1.	Practical examination	External	25

Course Objectives

1	To explain the process control loop, component symbols and process variables.
2	To introduce workings and applications of the transmitter, controller, converter and final control element.

CourseOutcomes: Studentswillbeableto

INMNR402.1	demonstrate the application of DPT for Flow and level measurement.
INMNR402.2	explain the procedure of calibration of DPT and converters and measurement with it
INMNR402.3	implement the circuit for on-off controller.
INMNR402.4	describe effects of control actions for pressure control loop.
INMNR402.5	demonstrate the Z-N closed loop tuning method to tune PID parameters
INMNR402.6	describe quick opening, linear and equal percentage control valve characteristics.

List of Experiments: Students are required to perform minimum 08 experiments from the given list.

1. Measurement of flow rate with DPT.
2. Measurement of level using DPT.
3. Calibrate Differential pressure transmitter.
4. Calibrate I to P converter and plot its input-output response.
5. Calibrate P to I converterand plot its input-output response.
6. Implement the On-Off controller circuit.
7. Verify the effect of different proportional controller gain for pressure control loop.
8. Verify the effect of proportional- integral controller for pressure control loop.
9. Tune the controller for temperature/pressure control loop using Z-N closed loop method.
10. Tunethe controller for level/flow control loopusing Z-N closed loop method.

11. Study various parts of control valve and plot the quick opening, linear and equal percentage type installed characteristics.

TextBooks:

1. Sawhney A. K, "Electrical and Electronics Measurements and Instruments" Dhanpat Rai & Co. 02nd Ed
2. W. D. Cooper & A. D. Helfrick, "Electronic Instrumentation and MeasurementTechniques" PHI, 4th e/d, 1987
3. DavidA.Bell," Electronic Instrumentation and Measurements", PHI, 2e/d

ReferenceBooks:

1. Anand M. M. S., "Electronic Instruments and Instrumentation Technology", PHI, 2004, 02nd Ed.
2. Kalsi H. S., " Electronic Instrumentation", TMH, 2nd or 3rd e/d, 2004/2010.
3. R. Subburaj, "Calibration the Foundation for ISO 9000 and TQM".
4. Bouwens A. J., "Digital Instrumentation", McGraw-Hill, second edition.